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ABSTRACT

Polyvinyl chloride (vinyl or PVC) is a substance widely used in children's products. Because children in contact with these products may ingest substantial quantities of potentially harmful chemicals during normal play, especially when they chew on the product, this Greenpeace study examined the levels of lead and cadmium in a variety of consumer products. A collection of 131 PVC products, including clothing, backpacks, toys, and household items, were purchased (in the Chicago area) at national chain stores such as K-Mart, Walmart, Target, and Toys R Us. Findings indicated that about 20 percent of the products contained from 100 to over 22,000 parts-per-million lead, with 18 percent of the products exceeding the maximum lead limit recommended by the Consumer Product Safety Commission. All the lead-containing products contained varying levels of cadmium, a known carcinogen. The study was replicated with the same results with products purchased in California, 10 major U.S. cities and Montreal, Canada. Several products released lead- or cadmium-contaminated dust over a 4-week period. (Additional materials appended to this report include a consumer bulletin, the summary of an additional study on the level of phthalates in PVC products, a scientific contact list, and background information on soft PVC toys. Five separately issued news releases, fact sheets, and copies of newspaper articles are appended; they discuss: lead and cadmium toxicity, exposure, and regulation; the reason for the Greenpeace investigation; regulation of lead in vinyl products, stabilizers in PVC, and the materials and methods used in the study. Contains about 35 references.) (KB)

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LEAD AND CADMIUM IN VINYL CHILDREN'S PRODUCTS

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Lead and Cadmium in Vinyl Consumer Products

A Greenpeace Exposé

Joseph Di Gangi, PhD
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Summary

A Greenpeace investigation revealed the presence of hazardous levels of lead and cadmium in a variety of vinyl consumer products, including items specifically designed and marketed for children. The study was spurred by the discovery of hazardous lead levels in vinyl blinds and associated lead poisoning of children in 1996. Since no government agency appeared to be investigating whether other vinyl consumer products might also pose a similar health risk, Greenpeace initiated a nationwide study of vinyl products.

The Greenpeace investigation discovered:

- Lead is present in vinyl products throughout the US. A survey of 10 major US cities showed the presence of many lead-containing products. They were also found in Montreal, Quebec, Canada.
- Lead- and cadmium-containing vinyl products are readily available from some of the nation's leading retailers, including Kmart, Wal-Mart, Target, and Toys R Us.
- Children are a marketing target. Products featured Barbie, Minnie and Mickey Mouse, 101 Dalmations, Michael Jordan, Bugs Bunny, and various other Looney Tunes characters.
- Lead-containing vinyl products are common. The investigation began by testing vinyl children's products purchased in Chicago. Twenty-one percent of the vinyl consumer products examined contained greater than 100 parts-per-million lead (28 out of 131). Since all of the items were purchased at national chain stores, this high percentage may reflect the US frequency for lead-containing vinyl products.
- The lead levels are hazardous. Eighteen percent of the products examined violated the limit advocated by the Consumer Product Safety Commission staff for vinyl miniblinds.
- Cadmium is an added hazard. In every case in which it was measured, all of the lead-containing products also contained varying levels of cadmium, a known carcinogen and renal toxin which is not regulated in children's products by the Consumer Product Safety Commission.
- Lead- and cadmium-containing vinyl products are widely available in California, despite its stringent regulation of carcinogens and reproductive toxins. A representative sample of items grossly exceeded limits for exposure to lead and cadmium set by the Safe Drinking Water and Toxic Enforcement Act of 1986, also known as Proposition 65.
- Both lead and cadmium are readily available for ingestion by children. Lead and cadmium were released to the surfaces of products as they aged. Lead also became available under conditions that mimic accidental swallowing.

The study began in Chicago with a mix of 131 vinyl products (also known as PVC or polyvinyl chloride). The items were bought at national chain stores and included vinyl clothing, backpacks, cables, toys, and household items. Lead testing by an independent

laboratory showed that about one-fifth of the products (28) contained from 100 to over 22,000 parts-per-million (ppm) lead.

Lead and cadmium in vinyl consumer products

Item	Store	Lead (ppm)	Cadmium (ppm)
backpack; Minnie's Spring Fever	Disney	163	224.5
backpack; 101 Dalmations	Kmart	104	321.0
backpack; Barbie	Kmart	372	75.7
barbell, 2lb vinyl cover	Target	7,050	12.4
breast milk cooler; Medela	Target	375	29.3
cable; Sega Controller	Toys R Us	4,100	17.4
cable; Gemini 3' video coaxial	Kmart	7,505	10.3
cable, Gemini mod. Phone cord	Kmart	865	15.3
cable; Philco in-ear headphones	Kmart	3,770	11.0
cable; Philco headphones	Kmart	3,490	52.4
cable; AT&T 25' phone line cord	Kmart	213	6.5
cable, Gemini computer printer	Kmart	5,765	18.1
key ring; Disney Minnie Totes	Target	1,430	6.1
pencil case; Fun d Mentals	Kmart	197	25.6
placemat, Warner Bros. Space J	Kmart	178	7.9
placemat, Barth & Dreyfuss	Kmart	398	6.2
placemat; Gloria Vanderbilt	Wal-Mart	505	12.0
purse, Pacific Kids	Wal-Mart	349	104.8
rain hat; Warner Bros. Tweety	Warner Bros.	4,060	35.4
rain coat; Columbia Youth Parka	Uncle Dan's	22,550	47.9
shower curtain; Springs Bath	Wal-Mart	864	105.5
tent pole; Barbie Slumber	Toys R Us	6,105	14.6
totebag; Tweety	Wal-Mart	459	228.5
toy; Looney Tunes hackey sack	Toys R Us	1,610	nd
toy; Kentucky Fried Chicken	Toys R Us	207	344.0
toy; Toteables cosmetics pouch	Target	392	152.0
toy; Dimples doll stroller	Toys R Us	7,115	22.6
umbrella; Looney Tunes	Toys R Us	817	27.0

Abbreviations: ppm, parts-per-million by weight in product; nd, not determined. All products shown were purchased in Chicago, Illinois. A representative sample of these products contained lead in cities throughout the US. See Results and Discussion for data and information regarding other cities. The Consumer Product Safety Commission staff-recommended limit for lead in vinyl is 200 ppm. Cadmium is not regulated by the Consumer Product Safety Commission. Proposition 65 regulates cadmium at one-tenth the level set for lead. Results shown are averages of duplicates. The average coefficient of variation was 9% and 22% for lead and cadmium respectively.

Eighteen percent of the products exceeded the maximum lead limit in vinyl formally recommended by the staff of the Consumer Product Safety Commission for vinyl

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miniblinds (200 ppm). More than half of these lead-containing vinyl products contained over 600 ppm lead and therefore would have been illegal and recalled if they had been made out of a regulated material like painted wood. In addition, all of the lead-containing products also contained varying levels of cadmium, a known carcinogen and kidney toxin which is not regulated in children's products.

The investigation widened to include California since it has the most stringent regulation of lead and cadmium in the US. A group of the items found to contain lead in Chicago was also purchased in Los Angeles and San Francisco and tested for both toxic metals. All seventeen products contained both lead and cadmium at levels previously seen in Chicago. Despite evidence that both metals are available for ingestion, none of the items carried labels warning California parents or children about the presence of either lead or cadmium as required by Proposition 65.

The study expanded to include 10 major US cities and Montreal. A representative sample of 19 lead-containing items from Chicago was sought in each locale. Not all of the products were found in every city, but all of the items which were purchased and tested contained lead. Seventeen of the 19 items in the sample exceeded the Consumer Product Safety Commission staff-recommended limit in the nationwide survey. The results indicate that vinyl products containing lead are readily available throughout the US and in at least one major Canadian city.

In order to determine whether the vinyl items might release toxic lead or cadmium during foreseeable use over the lifetime of these products, Greenpeace tested the possible availability of the metals. Two studies were conducted by independent laboratories using Consumer Product Safety Commission protocols.

Three commonly chewed products were examined to determine if they might release lead to a child's body. The data demonstrated that swallowing less than one-hundredth of an ounce of either a Gemini phone cord, Disney key ring, or Kentucky Fried Chicken toy would exceed the exposure limit used by the Consumer Product Safety Commission. Even swallowing less than one-thousandth of an ounce would release more than four times the amount of lead legally permitted under California's Proposition 65. Most importantly, it may not be necessary to actually swallow an item to be poisoned by it since simply chewing and sucking on plastic cables is a known source of lead poisoning.

Seven products were tested to determine whether lead or cadmium could be released to the surface during aging. Lead- or cadmium-contaminated dust is especially hazardous since it can easily enter the body by licking, chewing, inhalation, and hand-to-mouth behavior. A Minnie Mouse backpack, 101 Dalmations backpack, Barbie backpack, Tweety totebag, Columbia rain coat, Barbie tent pole, and Warner Bros. rain hat all released lead during four weeks of laboratory aging. Cadmium was released by five of the six products that were examined. All levels of lead and cadmium on the product surfaces exceeded the Proposition 65 limits for both metals. Lead was also detected on the

surfaces of all seven products right out of the package. The likely use of several vinyl products by a child would further increase the amount of lead and cadmium exposure.

The health hazard posed by lead in vinyl products is not just theoretical. In 1996, unexplainable high blood lead levels in children from Arizona, North Carolina, and Virginia provoked an investigation by the Departments of Health. Unexpectedly, vinyl miniblinds were identified as the common source of lead dust. An investigation by the Consumer Product Safety Commission found that new vinyl miniblinds contained from 7,700 to 12,300 ppm lead. In contrast, painted toys are recalled by the agency if they contain greater than 600 ppm lead. The Consumer Product Safety Commission estimated that 25 million vinyl miniblinds containing lead are imported into the US each year. An experimental study conducted by the agency demonstrated that light degraded the vinyl blinds and caused the formation of toxic lead dust which was apparently ingested by the children.

The Consumer Product Safety Commission issued a warning to the public and also entered into a voluntary agreement with the Window Covering Safety Council, the trade association of vinyl blind manufacturers. The agency sought reductions in lead content in vinyl miniblinds to the lowest level possible. The agency staff recommended a limit of 200 ppm lead in vinyl due to the cumulative health hazards posed by lead poisoning. Retailers were instructed to place a warning label on brands known to contain lead. Several months later, Greenpeace found unlabeled, lead-containing miniblinds featured in K-Mart's 1996 Labor Day Sale. The blinds were deeply discounted and present in Kmart stores across the US.

In contrast to the federal advisory to retailers, the State of California filed suit against companies that made or sold lead-containing blinds. Twelve companies including Wal-Mart, Kmart, J. C. Penney, and Montgomery Ward & Co. were named as defendants for violating Proposition 65.

The initial discovery of lead in vinyl blinds was surprising to the public, yet the industry has been using lead stabilizers and pigments in vinyl since the 1950s. Vinyl contains chlorine and therefore requires the addition of metals that act as stabilizers to retard degradation.

Lead causes irreversible nervous system damage, decreased intelligence, behavioral abnormalities, and learning disabilities. Lead also interrupts normal kidney function and blood formation. Cadmium can cause kidney damage and lung cancer. Both metals are developmental and reproductive toxins and cause damage at extremely low doses. Children are especially susceptible to these metals and no children's product should contain them. Neither metal is regulated in vinyl consumer products.

Findings

- Lead and cadmium are widely present in vinyl consumer products including those designed for children.
- The amount of lead present in many vinyl consumer products exceeds current Consumer Product Safety Commission regulations as well as the formal staff-recommended limit for lead in vinyl.
- Lead and cadmium in vinyl consumer products represent a health hazard since both are inevitably released as toxic dust when the product deteriorates.
- The amount of lead and cadmium released by a representative sample of vinyl consumer products violates California's Safe Drinking Water and Toxic Enforcement Act of 1986.

Factors

- Lead is a neurotoxin. Cadmium is a renal toxin and carcinogen. Both metals are highly toxic and especially damaging to children.
- Lead and cadmium are widely present in vinyl consumer products as stabilizers, components of pigments, or as contaminants.
- Lead is not regulated in vinyl consumer products by the Consumer Product Safety Commission. An agency staff-recommended limit was not adopted.
- Cadmium is not regulated in consumer products by the Consumer Product Safety Commission.
- There are alternative materials for all consumer uses of vinyl.

Recommendations

1. Parents should not purchase vinyl or PVC products to which children might be exposed including but not limited to rain coats, umbrellas, clothing, backpacks, ponchos, school supplies, purses, sports equipment, and toys. Vinyl children's products should be returned to the manufacturer or retailer.

2. Retailers, distributors, and manufacturers should remove vinyl children's products containing lead and/or cadmium from the market.

3. The Consumer Product Safety Commission should prohibit the use of lead and cadmium in consumer products such as vinyl. Vinyl children's products containing lead or cadmium should be recalled by the agency. A recall level should be set low enough to prohibit the entry of lead- and/or cadmium-containing products like the vinyl backpacks shown in Table 1, into the market.

4. Vinyl products sold in California should be tested for lead and cadmium and labeled by retailers and manufacturers if they are found to contain either metal. The State of California should pursue legal action against manufacturers and retailers selling lead- and cadmium-containing consumer products that violate the Safe Drinking Water and Toxic Enforcement Act of 1986 (also known as Proposition 65).

5. Retailers and trademark licensers should not market vinyl products to which children might be exposed. This should be made explicit in future sales and licensing agreements.

6. The plastics industry and toy manufacturers, through trade associations such as the Society of Plastics Industry and the Toy Manufacturers of America, should adopt an industry-wide standard against manufacturing children's products with vinyl.

Introduction

In 1996, the unexplained lead poisoning of children in three states provoked an investigation that identified vinyl blinds as the common source of lead dust.[1] The blinds were not suspected to be a source of lead even though vinyl has contained lead stabilizers since the 1950s. Vinyl requires the addition of metal stabilizers because it contains chlorine (vinyl is also known as polyvinyl chloride or PVC). Without a stabilizer, the chlorine can degrade the product by forming hydrochloric acid. Lead effectively stabilizes bound chlorine and binds any free chlorine that might be formed during processing or degradation.[2] Lead is also used in various pigments that color plastic.

There are three important aspects of the lead poisoning associated with vinyl blinds. First, lead poisoning is one of the most serious preventable public health hazards in the US.[3] Lead decreases intelligence and damages the nervous system at extremely low doses.[4, 5] Its effects are cumulative and irreversible.[6] Second, lead has a long history of serving the obligatory role of stabilizer in vinyl products. Finally, lead is released from vinyl during product degradation. The Consumer Product Safety Commission experimentally demonstrated that light and heat can cause degradation of vinyl and liberation of lead dust.[7] Unfortunately for children, vinyl miniblinds release lead during normal product use.[8]

Given the serious health effects of lead and its inevitable release from vinyl blinds that contain it, Greenpeace asked whether other vinyl consumer products might also pose a lead hazard. Lead testing of vinyl consumer products began in Chicago, then widened to include 10 major US cities and Montreal, Canada. Preliminary studies of bioavailability were conducted to determine the consequence of accidental swallowing. An accelerated aging study was conducted to determine whether toxic dust might be formed during product degradation.

Materials and Methods

Please see Appendix V

Results and Discussion

A random survey in Chicago reveals lead-containing vinyl products

An investigation of vinyl consumer products in Chicago showed that many of them contained lead (Table 1). Roughly 20% of the 131 products that were surveyed contained lead. Table 1 shows 28 lead-containing vinyl items that were purchased at national chain stores like Kmart, Toys R Us, Target, and Wal-Mart. The products include a variety of common school products, clothing, toys, and household items. Eighty-six percent of the lead-containing items in Table 1 exceeded the 200 ppm standard for lead in vinyl proposed by Consumer Product Safety Commission staff. In fact, more than half of the lead-containing items contained greater than 600 ppm lead and therefore would have been illegal and recalled if they had been painted wooden toys.

Children are the marketing target

The vinyl items containing lead included items with popular children's characters like Minnie Mouse, 101 Dalmations, Barbie, various Looney Tunes characters, and even Michael Jordan (Table 1). Other vinyl products containing lead included common household items used by children such as a cable for a Sega Genesis video game, various phone cords, a VCR cable, and headphone cables (Table 1). The lead-containing list even included vinyl placemats whose normal proximity to food is especially troubling. Various vinyl clothing items also contained lead. A Warner Bros. rain hat featuring Tweety contained over 4,000 ppm lead and a popular Columbia rain coat for children showed over 22,000 ppm lead (Table 1). Several toys easily available for sucking or even designed for it contained lead. A small hackey sack featuring Warner Bros. Looney Tunes characters contained over 1,600 ppm lead. A Kentucky Fried Chicken toy destined for children's mouths contained roughly 200 ppm lead. A simple vinyl pouch containing cosmetics had nearly 400 ppm lead and a doll stroller for little girls showed over 7,000 ppm lead.

Vinyl products also contain cadmium

All of the vinyl products containing lead also contained cadmium. In some cases the levels of cadmium were even higher than the lead levels. Since cadmium is even more toxic than lead, the results are especially surprising. Especially alarming is the presence of cadmium in a Kentucky Fried Chicken toy designed to put into children's mouths. Each gram of this toy contained over 340 μg cadmium (μg is a microgram or one-millionth of a gram). Both the Minnie Mouse and 101 Dalmations backpacks also contained unexpected levels of the carcinogenic metal. Each gram of the two backpacks contained 225 and 321 μg of cadmium respectively. The total amount of cadmium in the product adds up rapidly. For example, the 101 Dalmations backpack weighs roughly 300 g and therefore contains about 96,300 μg cadmium. To place the results in perspective, the limit for exposure to inhaled cadmium dust in California is 0.05 μg per day. This represents 1.8 billionths of an

ounce per day. The 101 Dalmations backpack contained nearly 2 million times this level of cadmium.

Table 1. Lead and cadmium in vinyl consumer products purchased in Chicago.

Item	Store	Lead (ppm)	Cadmium (ppm)
backpack; Minnie's Spring Fever	Disney	163	224.5
backpack; 101 Dalmations	Kmart	104	321.0
backpack; Barbie	Kmart	372	75.7
barbell; 2lb vinyl cover	Target	7,050	12.4
breast milk cooler; Medela	Target	375	29.3
cable; Sega Controller	Toys R Us	4,100	17.4
cable; Gemini 3' video coaxial	Kmart	7,505	10.3
cable; Gemini mod. Phone cord	Kmart	865	15.3
cable; Philco in-ear headphones	Kmart	3,770	11.0
cable; Philco headphones	Kmart	3,490	52.4
cable; AT&T 25' phone line cord	Kmart	213	6.5
cable; Gemini computer printer	Kmart	5,765	18.1
key ring; Disney Minnie Totes	Target	1,430	6.1
pencil case; Fun d Mentals	Kmart	197	25.6
placemat; Warner Bros. Space J.	Kmart	178	7.9
placemat; Barth & Dreyfuss	Kmart	398	6.2
placemat; Gloria Vanderbilt	Wal-Mart	505	12.0
purse; Pacific Kids	Wal-Mart	349	104.8
rain hat; Warner Bros. Tweety	Warner Bros.	4,060	35.4
rain coat; Columbia Youth Parka	Uncle Dan's	22,550	47.9
shower curtain; Springs Bath	Wal-Mart	864	105.5
tent pole; Barbie Slumber	Toys R Us	6,105	14.6
totebag; Tweety	Wal-Mart	459	228.5
toy; Looney Tunes hackey sack	Toys R Us	1,610	nd
toy; Kentucky Fried Chicken	Toys R Us	207	344.0
toy; Toteables cosmetics pouch	Target	392	152.0
toy; Dimples doll stroller	Toys R Us	7,115	22.6
umbrella; Looney Tunes	Toys R Us	817	27.0

Abbreviations: ppm, parts-per-million by weight in product; nd, not determined. Results shown are averages of duplicates. The average coefficient of variation was 9% and 22% for lead and cadmium respectively. The Consumer Product Safety Commission staff-recommended limit for lead in vinyl is 200 ppm. Cadmium is not regulated by the Consumer Product Safety Commission. Proposition 65 regulates cadmium at one-tenth the level set for lead.

Vinyl products in California contain lead and cadmium

Since lead and cadmium are stringently regulated in the state of California, a representative sample of the Chicago vinyl products was purchased in San Francisco and

Los Angeles and tested for the presence of lead and cadmium. Table 2 shows that the same pattern of lead and cadmium content that was observed in products from Chicago was seen in those from California. Seventeen different vinyl products contained between 180 and 7,780 ppm lead. More than 80% of the products violated the Consumer Product Safety Commission staff-recommended limit of 200 ppm lead in vinyl.

Though cadmium is more stringently regulated than lead in California, its presence was ubiquitous in items containing lead. In a few cases, the levels of cadmium rivaled or even exceeded the lead levels. The Disney Minnie Mouse backpack, Kmart 101 Dalmations backpack, Barbie backpack, shower curtain, and Kentucky Fried Chicken toy contained extremely high amounts of cadmium (Table 2). Each gram of the items contained between 235 and 650 μg cadmium even though they were purchased in a state that only permits 0.05 μg exposure to cadmium dust per day.

Agency	Lead	Cadmium
Consumer Product Safety Commission	paint: 600 ppm vinyl: 200 ppm*	not regulated
State of California	0.5 μg/day	0.05 μg/day inhalation

Abbreviations: ppm, parts-per-million by weight in product. *Proposed by Consumer Product Safety Commission staff following discovery of lead in vinyl blinds.

Disney, Warner Bros. and Mattel products contain toxic metals

Ironically, many of the California products containing lead and cadmium also featured children's icons of several California-based companies including Disney, Mattel, and Warner Bros. Backpacks featuring Minnie Mouse and 101 Dalmations containing both lead and high amounts of cadmium were available at the Disney Store and Kmart in Los Angeles and San Francisco respectively. Mickey Mouse is prominently featured on a children's key ring containing over 240 ppm lead. Mattel's Barbie is featured on a backpack containing over 400 ppm lead and 200 ppm cadmium. Barbie is also featured in a children's slumber tent that contains tent poles with 4,685 ppm lead in Los Angeles and 7,400 ppm lead in a tent purchased in San Francisco. Warner Bros. was also represented among lead-containing vinyl products for children. A rain hat containing over 2,700 ppm lead and featuring Tweety was purchased in the Warner Bros. store in both California cities. A Looney Tunes hackey sack contained either over 300 ppm lead in Los Angeles or over 1,600 ppm lead in San Francisco. A Space Jam placemat featuring Michael Jordan contained 180 ppm lead. Finally, a Looney Tunes children's umbrella available in Los Angeles and San Francisco contained over 650 ppm lead and 50 ppm cadmium in both cities. None of the products contained labels warning California consumers and children about the presence of either lead or cadmium.

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Table 2. Lead and cadmium in vinyl consumer products purchased in California

Item	Store	Lead (ppm)	Cadmium (ppm)
backpack, Minnie's Spring Fever	Disney; LA	263	242.0
backpack, Minnie's Spring Fever	Disney; SF	255	238.5
backpack; 101 Dalmations	Kmart; LA	226	499.0
backpack; 101 Dalmations	Kmart; SF	288	440.0
backpack; Barbie	Kmart; SF	417	242.0
barbell; 2lb vinyl cover	Target; SF	7,780	7.2
cable; Sega Controller	Toys R Us; SF	4,755	14.1
cable; Gemini 3' video coaxial	Kmart; LA	4,910	9.6
cable; Gemini 3' video coaxial	Kmart; SF	6,965	24.3
cable; Gemini mod. phone cord	Kmart; LA	679	6.8
cable; Gemini mod. phone cord	Kmart; SF	5,290	36.7
cable; Philco in-ear headphones	Kmart; LA	5,910	5.6
cable; Philco in-ear headphones	Kmart; SF	4,700	27.3
key ring; Disney Minnie Totes	Target; SF	242	17.0
placemat; Warner Bros. Space J.	Kmart; LA	180	6.9
rain hat; Tweety	Warner Bros.; LA	2,755	39.0
rain hat; Tweety	Warner Bros.; SF	2,835	51.5
shower curtain, Springs Bath	Wal-Mart; LA	477	425.0
tent pole; Barbie Slumber	Toys R Us; LA	4,685	11.8
tent pole; Barbie Slumber	Toys R Us; SF	7,400	8.3
toy; Looney Tunes hackey sack	Toys R Us; LA	316	45.1
toy; Looney Tunes hackey sack	Toys R Us; SF	1,675	53.9
toy; Kentucky Fried Chicken	Toys R Us; LA	125	649.0
toy; Kentucky Fried Chicken	Toys R Us; SF	110	363.5
umbrella; Looney Tunes	Toys R Us; LA	656	46.7
umbrella; Looney Tunes	Toys R Us; SF	695	50.3

Abbreviations: ppm, parts-per-million by weight in product. LA, Los Angeles, CA; SF, San Francisco, CA. Results shown are averages of duplicates. Average coefficient of variation was 14% and 16% for lead and cadmium respectively. The Consumer Product Safety Commission staff-recommended limit for lead in vinyl is 200 ppm. Cadmium is not regulated by the Consumer Product Safety Commission. Proposition 65 regulates cadmium at one-tenth the level set for lead.

Pilot study in Canada confirms the US pattern

A small pilot study to determine whether vinyl products in Canada might also contain lead and cadmium was conducted by examining thirteen items purchased in Montreal, Quebec. Eight of the thirteen items contained significant amounts of lead (Table 3). The products included popular children's characters like 101 Dalmations, Barbie, and Minnie Mouse. Table 3 shows that half of the items violated the 600 ppm

standard currently in use in Canada. Health Canada is proposing a 15 ppm limit for lead in children's and other consumer products.[9] The 101 Dalmations and Barbie backpacks, Sega Genesis cable, and Columbia rain coat all contained lead as discovered in various US cities (Tables 3 and 4). The items also contain cadmium as discovered in the US sampling. A Minnie Mouse poncho, 101 Dalmations backpack, and waterproof jacket all contained greater than 45 ppm cadmium. As in the US, all the lead- and cadmium-containing items were readily available at common chain stores.

Table 3. Lead and cadmium in vinyl products purchased in Montreal

Item	Store	Lead (ppm)	Cadmium (ppm)
backpack; 101 Dalmations	Toys R Us	110	55.0
backpack; Barbie	Toys R Us	610	4.0
barbell; 2lb vinyl cover	Sports Experts	247	29.0
cable; Sega Controller	Toys R Us	5,415	6.0
jacket; black waterproof	Zellers	234	143.0
poncho; Minnie Mouse Suite 100	Wal-Mart	99	46.0
rain coat; Columbia	Sports Experts	18,600	8.0
rain pants; Columbia	Sports Experts	18,750	18.0

Abbreviations: ppm, parts-per-million by weight in product. Results shown are averages of duplicates. Average coefficient of variation was 14% and 15% for lead and cadmium respectively. The limit for lead in consumer products currently used in Canada is 600 ppm. Health Canada is currently proposing a 15 ppm limit for lead in children's and consumer products.

A national problem in the US

To determine whether lead in vinyl consumer products represented a national problem, a representative sample of the Chicago items was purchased in a variety of US cities and analyzed for lead. The US cities were: Boston, MA, Boulder, CO, Chicago, IL, Los Angeles, CA, Minneapolis, MN, New Orleans, LA, New York, NY, Portland OR, San Francisco, CA, Seattle, WA, and Washington, D.C. The results indicate that vinyl consumer products containing hazardous lead levels are widely available throughout the United States and in at least one major Canadian city (Table 4). Not all of the items were available in every city, but Table 4 shows that items originally found to contain lead in Chicago also contained lead in every city examined. Seventeen of the 19 items averaged greater than the 200 ppm standard recommended by the Consumer Product Safety Commission staff. The results also show a large variation in lead content throughout the US and even in different cities within the same state. This is surprising considering that almost all of the products were purchased at national chain stores like Kmart, Wal-Mart, Target, and Toys R Us. The data suggests that a low lead or cadmium level in one city may not guarantee the safety of the same product purchased in a different store, city, state, or country.

Table 4. Lead in vinyl products purchased in various cities

Item	Average Lead (ppm)	Low (ppm)	High (ppm)	Total Tests (n)	Cev (%)	Cities Tested
backpack; Minnie's	286	132	637	9	49	Bos, Chi, LA, Min, SF
backpack; 101 Dalm.	198	97	374	19	44	Bos, Bou, Chi, LA, Mon, Min, NO, SF, DC
backpack; Barbie	417	236	627	8	33	Chi, SF, Mon, DC
barbell; 2lb vinyl	5,271	824	8,610	6	67	Chi, SF, Sea
cable; Sega Genesis	5,045	2,490	7,160	15	21	Bos, Chi, Mon, NO, NY, SF, DC
cable; Gemini video	6,803	4,250	12,600	17	30	Bos, Chi, LA, NO, NY, SF, Sea, DC
cable; Gemini phone	2,130	393	5,350	13	91	Chi, LA, NO, NY, SF, DC
cable; Philco in-ear	4,845	3,610	6,150	13	18	Bos, Chi, LA, NO, SF, Sea, DC
cable; AT&T phone	4,203	207	7,260	6	76	Bos, Chi, Sea
key ring; Disney	836	234	1,570	4	83	Chi, SF
placemat; Space Jam	244	126	426	14	41	Bou, Chi, LA, Min, Sea, DC
rain hat; Tweety	2,631	680	4,200	8	49	Bos, Chi, LA, SF
rain coat; Columbia	23,211	16,800	28,600	9	15	Bos, Chi, LA, Mon, Por, SF
shower curtain; Spr	665	445	889	12	27	Bos, Bou, Chi, LA, Min, NO, Sea, DC
tent pole; Barbie	5,962	2,830	12,500	17	41	Bos, Bou, Chi, LA, NO, SF, Sea, DC
totebag; Tweety	679	409	1,093	4	45	Bos, Chi
toy; L. Tunes hackey	1,774	190	7,490	8	136	Bou, Chi, NO, SF, DC
toy; KFC	177	97	420	12	50	Bos Chi, LA, Sea, SF, DC
umbrella; L. Tunes	661	416	852	14	19	Bos, Chi, LA, NO, NY, SF, Sea, DC

One item from each city was tested. Abbreviations as above plus: Cev, coefficient of variation, the standard deviation expressed as a percent of the mean; Bos, Boston, MA; Bou, Boulder, CO; Chi, Chicago, IL; LA, Los Angeles, CA; Mon; Montreal, Quebec, Canada; Min, Minneapolis, MN; NO, New Orleans, LA; NY, New York, NY; Por, Portland, OR; SF, San Francisco, CA; Sea, Seattle, WA; DC, Washington, D.C.

Lead and cadmium as ingredients in vinyl

The overall variation in lead and cadmium levels seen in the various consumer products could occur for various reasons. Since metal stabilizers are typically added at levels greater than 5,000 ppm, vinyl items containing high amounts of lead are probably stabilized with it. Items with lower amounts of lead may reflect contamination in the manufacturing process. In addition, cadmium and lead are both used in pigments that color vinyl. Items colored with these pigments could also contain high amounts of either metal. Unfortunately, vinyl always requires some sort of metal stabilizer to protect the plastic during processing due to the presence of chlorine in the polymer (see Appendix IV). This structural obligation for metal stabilizers makes the prospect of making a "clean" vinyl product doubtful.

Absorbing lead from chewing and swallowing vinyl

The chewing and swallowing behavior of children is a common source of lead exposure. However, swallowing is not even necessary for exposure. Simply chewing and sucking on plastic cables is a known source of lead poisoning.[10] Three commonly chewed products were incubated under mild acid conditions at body temperature using Consumer Product Safety Commission protocols. The experiment explored whether ingesting even a tiny amount of a Gemini phone cord, Disney Minnie Totes key ring, or Kentucky Fried Chicken toy could pose a risk.

The results show that swallowing less than one-hundredth of an ounce of vinyl would release measurable quantities of lead. In fact, Table 5 shows that all three items exceeded the ingestion limit used by the Consumer Product Safety Commission (15 µg/day). The agency limit is 30 times higher than the maximum ingestion level permitted in California under Proposition 65. The Commission uses it despite acknowledging that "...any ingestion of lead is undesirable because the effects of lead ingestion are cumulative, and other sources of lead may be available to children."[11]

Table 5. Migration of lead under conditions that mimic swallowing 250 mg of an item (0.00881 ounces)

Item	Store	Available Lead (µg)
cable; Gemini modular phone cord	Kmart	21.6
key ring; Disney Minnie Totes	Target	34.2
toy; Kentucky Fried Chicken	Toys R Us	23.0

Abbreviations: µg, micrograms. All products were purchased in Chicago, Illinois. Items treated using Consumer Product Safety Commission protocols for extractable lead as described in Appendix V. The permitted exposure level for lead under California's Proposition 65 is 0.5 µg/day.

The data also demonstrates that swallowing less than one-thousandth of an ounce of any product in Table 5 would release enough lead to exceed the legal exposure limit of Proposition 65 by more than four-fold. The lead migration displayed by the vinyl Kentucky Fried Chicken is especially disturbing since the toy is actually designed to be put into children's mouths.

Contaminated dust is a health risk

Lead- or cadmium-contaminated dust is especially hazardous since it can easily enter the body in multiple ways. Routes of ingestion include licking, sucking, mouthing, inhalation, and hand-to-mouth behavior. Since real life behaviors encompass multiple exposure pathways, the data showing the presence of surface lead and cadmium was not confined to a specific route of ingestion. Instead, the results show the total amount of lead or cadmium that is available for ingestion on the product surface. Metals which are not ingested immediately can become part of the indoor environment and be ingested later by the same variety of pathways.

Lead dust is present on new vinyl products

Table 6 shows that lead dust was measured on the surfaces of seven products right out of the package. Lead levels on six products exceeded the Proposition 65 limit by 4 to 470 fold. Five of these products were purchased in California. More than half of the items contained lead dust at levels similar to, or greater than the Consumer Product Safety Commission ingestion limit.

Table 6. Lead and cadmium dust present on new vinyl children's products: exposures provided by average products

Item	Store	Lead (µg)	Cadmium (µg)
backpack; Minnie's Spring Fever	Disney, LA	1.984	nd
backpack; 101 Dalmations	Kmart; LA	19.430	1.740
backpack; Barbie	Kmart; SF	14.210	1.160
rain coat; Columbia	Columbia, Por	235.733	nd
rain hat; Tweety	Warner Bros.; LA	9.217	nd
tent pole; Barbie Slumber	Toys R Us; SF	13.404	nd
totebag; Tweety	Wal-Mart, Chi	0.240	nd

Abbreviations: µg, micrograms; nd, not detected; LA, Los Angeles, CA; SF, San Francisco, CA; Por, Portland, OR; Chi, Chicago, IL. Average exposures represent the mean of triplicates. The permitted exposure level for lead and cadmium under California's Proposition 65 is 0.5 µg/day and 0.05 µg/day respectively. Areas of products are as follows: Minnie's Spring Fever: 96 in^2; 101 Dalmations: 290 in^2; Barbie: 290 in^2; Columbia: 1,700 in^2; Tweety rain hat: 79 in^2; Barbie Slumber: 36 in^2; and Tweety totebag: 240 in^2

Two children's products were made even more dangerous by the additional presence of cadmium. Table 6 shows more than 1.1 μg of cadmium present on the surfaces of new 101 Dalmations and Barbie backpacks in addition to greater than 14 μg of lead dust. The cadmium levels are more than 23 to 35 times higher than the amount permitted in California, where they were purchased.

Vinyl products release toxic metals during degradation

Lead and cadmium were released as toxic dust during the degradation of vinyl children's products. Figure 1 shows the rapid release of lead from a Barbie tent pole under conditions used by the Consumer Product Safety Commission to demonstrate the liberation of lead from vinyl miniblinds. Figure 2 shows the increasing availability of cadmium on the surface of a 101 Dalmations backpack during aging. To our knowledge, Figure 2 represents the first demonstration of cadmium release from a vinyl consumer product during degradation.

Figure 1. Lead release during degradation of a Barbie tent pole

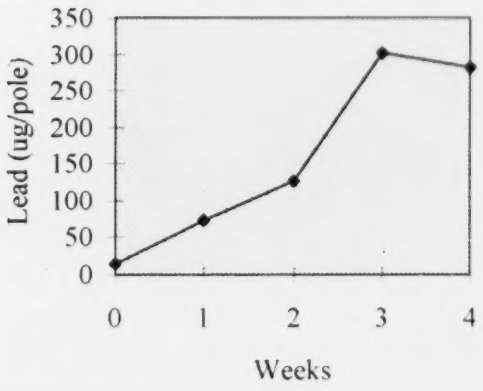
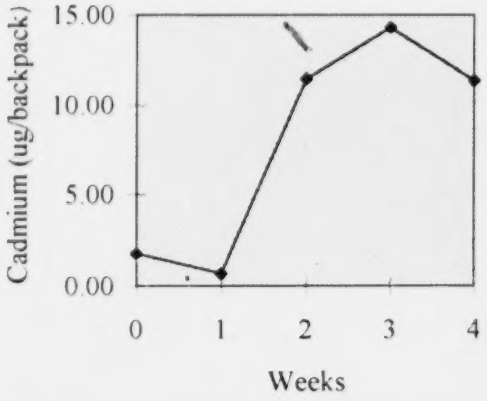


Figure 2. Cadmium release during degradation of a 101 Dalmations backpack



Abbreviations μg, micrograms. Average exposures representing the mean of triplicates were plotted for both figures. The permitted exposure level for lead and cadmium under California's Proposition 65 is 0.5 μg/day and 0.05 μg/day respectively.

Large amounts of lead and cadmium are released

Large amounts of lead-contaminated dust were released by vinyl children's products during four weeks of accelerated aging. Table 7 shows maximum surface lead levels between 5.6 μg and 336 μg. The lowest level occurred on the Disney Minnie's

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Spring Fever backpack. However, this backpack still produced more than 11 times the amount of lead legally permitted in California where it was purchased. The two highest amounts of lead dust were present of the surfaces of the Columbia rain coat and the Barbie Slumber tent pole. Both products released over 300 μg of lead dust; more than 600 times the Proposition 65 limit. In fact, all seven products violated the legal limit set by Proposition 65. Four of the products exceeded the limit used by the Consumer Product Safety Commission.

Table 7. Maximum lead and cadmium dust levels observed on the surfaces of vinyl products: exposures provided by average products

Item	Store	Lead (μg)	Cadmium (μg)
backpack; Minnie's Spring Fever	Disney; LA	5.664	5.792
backpack; 101 Dalmations	Kmart; LA	19.430	14.307
backpack; Barbie	Kmart; SF	35.380	23.393
rain coat; Columbia	Columbia; Por	336.033	nd
rain hat; Tweety	Warner Bros.; LA	9.217	0.263
tent pole; Barbie Slumber	Toys R Us; SF	302.484	ND
totebag; Tweety	Wal-Mart; Chi	8.800	15.520

Abbreviations: μg, micrograms; nd, not detected; ND, not determined. LA, Los Angeles, CA; SF, San Francisco, CA; Por, Portland, OR; Chi, Chicago, IL. Average exposures represent the mean of triplicates. The permitted exposure level for lead and cadmium under California's Proposition 65 is 0.5 μg/day and 0.05 μg/day respectively. See Table 6 for product areas.

Large amounts of easily ingestable cadmium dust were also released during degradation of vinyl children's products. Table 7 shows that the amount of cadmium released by all six products that were tested was 5 to 460 times higher than the Proposition 65 limit.

The use or presence of several vinyl products would further increase the amount of lead and cadmium available for ingestion. Table 7 shows that combining a Barbie backpack, Columbia rain coat, and Tweety rain hat, could quickly increase exposure to both toxic metals, especially if they were used multiple times each week or month. The hazard comes from the cumulative nature of lead poisoning.[12]

The most dangerous 10% of items would provide significant exposures

A statistical calculation revealed the amount of lead or cadmium that the most hazardous subset of product samples could provide. The estimate assumed a normal distribution and used the variation observed among replicates to calculate the 90th percentile level of either metal. The most dangerous 10% of samples could provide at least this amount of lead or cadmium.

Table 8. Minimum lead and cadmium exposures provided by the most hazardous 10% of items: statistical estimate

Item	Store	Lead (μg)	Cadmium (μg)
backpack; Minnie's Spring Fever	Disney; LA	14.824	6.678
backpack; 101 Dalmations	Kmart; LA	24.284	15.852
backpack; Barbie	Kmart; SF	83.692	35.840
rain coat; Columbia	Columbia; Por	590.554	nd
rain hat; Tweety	Warner Bros.; LA	12.415	0.497
tent pole; Barbie Slumber	Toys R Us; SF	486.925	ND
totebag; Tweety	Wal-Mart; Chi	20.495	16.762

Abbreviations: μg, micrograms; nd, not detected; ND, not determined. LA, Los Angeles, CA; SF, San Francisco, CA; Por, Portland, OR; Chi, Chicago, IL. The 90th percentile was calculated by adding ($z_{1.28}$ x sample standard deviation) to the mean. A normal distribution was assumed for the data set. The permitted exposure level for lead and cadmium under California's Proposition 65 is 0.5 μg/day and 0.05 μg/day respectively. See Table 6 for product areas.

Table 8 shows that the most hazardous samples of each product would provide exceptional exposures to both toxic metals. The only product which did not liberate cadmium was the Columbia rain coat. The most dangerous 10% of these rain coats would provide nearly 1,200 times the legal limit for lead set by Proposition 65 and 40 times the limit used by the Consumer Product Safety Commission. Cadmium was not measured on the Barbie tent pole, but this product could liberate 970 times the amount of lead permitted by Proposition 65.

The remaining 5 products contained both toxic metals on their surfaces. Lead levels ranged from 25 to 170 times higher than the Proposition 65 limit. Cadmium levels exceeded the limit by 10 to 335 fold. The presence of both lead and cadmium on the product surface represents a significantly greater hazard than the considerable danger posed by either toxic metal alone.

Appendix I. Lead and Cadmium Toxicity, Exposure, and Regulation

Lead poisoning is a significant health problem

Lead poisoning is widely recognized to be one of the most serious preventable public health hazards in the US.[13] In the period from 1991 to 1994, 890,000 children had blood lead levels defined as lead-poisoned.[14] In addition, a national phone survey in 1994 showed that only 24% of parents had screened their young children for lead, indicating that the true magnitude of the problem may be much larger.[15]

Lead causes irreversible nervous system damage and decreased intelligence at extremely low doses.[16, 17] Children are especially susceptible to lead poisoning because they absorb and retain more lead in proportion to their weight than adults.[18] Lead exposure in childhood has been associated with lower vocabulary and grammatical-reasoning scores, increased absenteeism, poorer eye-to-hand coordination, and lower class standing in high school.[19] Unfortunately, most children with lead poisoning are not overtly symptomatic.[20]

Defining the hazard

What is considered a "safe" level of lead by the medical community has declined significantly over the last thirty years. In the 1960s the Centers for Disease Control (CDC) action level for lead in blood was 60 μg/dl. This lead level results in mental retardation, kidney damage, male infertility, impaired growth, and hearing loss.[21] A decade later the medical community lowered the level to 30 μg/dl. In 1985, the action level dropped to 25 μg/dl and in 1991 it was modified downward to 10 μg/dl.

Current blood level standards for lead do not protect children. Even though 10 μg/dl is considered "safe" by some medical professionals, reduced birthweight, hearing loss, and attention deficit in children and monkeys have been observed at blood lead levels of 5 μg/dl.[22] In fact, recent analyses of lead exposure and children's IQ could find no evidence of a threshold, suggesting that there is no safe lead level and that the current 10 μg/dl standard permits nervous system damage.[23] Blood lead levels in preindustrial humans were estimated from bone measurements to be 0.016 μg/dl.[24] The current "safe" level of 10 μg/dl is 600 times higher than natural concentration of lead in blood.

Exposure to lead

One of the largest sources of lead exposure in the US is lead-contaminated dust. A common source is decaying paint that contaminates house dust and soil.[25] The permitted lead level in residential paint in the US was lowered to 600 ppm in 1978 but a huge reservoir of leaded paint in older housing stock continues to pose a hazard. Recalls are normally implemented when painted consumer products contain greater than 600 ppm lead. However, each product or source of lead is regulated separately. This allows for

exposures from a variety of sources, all of which might be below the particular regulatory level.[26] The health hazard comes from the cumulative nature of lead poisoning.[27]

Lead ingestion and poisoning typically occurs by licking, mouthing, or swallowing the item, through hand-to-mouth activity, or inhalation. Both hand-to-mouth activity and mouthing were indicated in the lead poisoning cases caused by vinyl blinds.[28] Inhalation and hand-to-mouth activity have been implicated in the lead poisoning of plastics workers.[29, 30, 31] Finally, chewing on plastic-covered electrical cables was also identified as a source of lead intoxication.[32]

California and lead regulation

The most stringent regulation of lead in consumer products is in the state of California. The Safe Drinking Water and Toxic Enforcement Act of 1986 (also known as Proposition 65) regulates chemicals known to cause cancer or reproductive toxicity. Lead qualifies under both categories. The law regulates chemicals by requiring clear warning labels on products containing hazardous amounts of toxins and by prohibiting businesses from dumping listed chemicals onto the land or into water. The maximum acceptable intake level of lead under Proposition 65 as a reproductive and developmental toxin is 0.5 µg/day. This represents 0.8 millionths of an ounce of the children's Columbia rain coat in Table 1. The California lead level was adopted in 1987. It was determined by dividing the Occupational Safety and Health Administration (OSHA) limit of 500 µg/day by a 1,000-fold safety factor as required under the law.[33]

California and cadmium regulation

The State of California also recognized cadmium as a carcinogen under Proposition 65 in 1987.[34] The no-significant risk level for inhaled cadmium dust was set at 0.05 µg/day, one-tenth the level set for lead. The standard was based upon studies demonstrating an association between cadmium and respiratory cancer in both humans and laboratory animals.[35] Injection of cadmium in animals produced tumors both at the site of injection and at other sites including testicular interstitial cells and pancreatic islet cells.[36]

Cadmium was also recently nominated for listing as a reproductive toxin under Proposition 65.[37] Cadmium was positively correlated with reduced birthweight, premature birth, stillbirth, spontaneous abortion, and birth defects in humans.[38] In addition, cadmium and lead were both correlated with behavioral problems and learning disabilities. In utero exposure to both lead and cadmium was correlated with motor and perceptual problems in six year old children.[39] Since cadmium can be absorbed orally, by inhalation, or even by dermal contact, the lack of regulation in children's products by the Consumer Product Safety Commission is surprising.

Incineration and exposure to lead and cadmium

Incineration also represents a potentially significant source of lead and cadmium exposure. The ash produced by municipal waste incinerators contains both toxic metals.[40] In addition, both metals can be inhaled from combustion gases or ingested since they are easily leached out of ash into soil or water.[41] The EPA estimated that plastic contributes 71% of the lead and 88% of the cadmium in the combustible portion of the municipal waste stream.[42] This combustible portion of municipal waste is the major contributor to toxic air emissions and ash.[43] Both metals have been used as stabilizers and pigments in vinyl production for decades.

The final destination for lead- and cadmium-containing consumer products is the trash. This provides another legal avenue for exposure to both toxic metals. Currently, existing municipal waste combustors that process 1,000 tons per day are permitted to release 18 g/million dry standard cubic feet of cadmium and 200 g/million dry standard cubic feet of lead. A typical incinerator releases 3,670 dry standard cubic meters at 7% oxygen per ton of unprocessed municipal solid waste.[44] Therefore, an existing municipal waste incinerator of this size can legally emit 2,334 g of cadmium and 25,921 g of lead each day. For new incinerators the regulations are more "stringent". A 1,000 ton per day municipal waste incinerator can release 1,127 g of cadmium and 11, 274 g of lead per day. Assuming an 8,000 hour operating year, an existing 1,000 ton per day incinerator can legally emit 1,713 pounds of cadmium and 19,032 pounds of lead per year. A new incinerator of this size is permitted to emit 826 pounds of cadmium and 8,278 pounds of lead annually.

Prevention is the key

Lead poisoning is both extremely serious and preventable. The American Academy of Pediatrics has stated that, "Identification and treatment of the child poisoned with lead continues to be essential, but of greater importance is *identification of the source* and *prevention of subsequent exposures* for that child and other children in the future."[45] One overlooked source of lead (and cadmium) is vinyl consumer products. Fortunately, there are alternative materials for all consumer uses of vinyl. Parents can prevent toxic metal exposure to their children by returning vinyl items and buying products made of alternative materials.

Appendix II. Why Greenpeace Decided to Investigate Lead in Vinyl Products

Vinyl blinds as a source of lead

In 1996, the Arizona, North Carolina, and Virginia Departments of Health discovered unexplainable hazardous lead levels in children. The results were puzzling due to the lack of lead-based paint as an explanation for the poisoning. In the original Arizona case, a 1 ½ year old lead-poisoned child lived in a trailer that did not even have interior paint.[46] The investigation unexpectedly yielded vinyl miniblinds as the common source of lead dust. The mere presence of lead in vinyl blinds was surprising to the public even though it has been widely used as an additive in vinyl to retard decomposition since the 1950s.

An investigation by the Consumer Product Safety Commission revealed that ultraviolet (UV) light-degradation of the blinds caused the release of lead dust which was apparently subsequently ingested by children.[47] The agency found that new vinyl miniblinds contained from 7,700 to 12,300 parts-per-million (ppm) total lead.[48] In contrast, the limit for lead in painted toys and consumer products has been 600 ppm since 1978.[49]

Deterioration and toxic dust

The Consumer Product Safety Commission conducted accelerated aging experiments to demonstrate whether the lead in vinyl blinds could become available as dust as the blinds deteriorated in the sun. Blinds were exposed to UV light and heat over a period of eight weeks. During exposure, increasing levels of surface dust containing lead were measured on the blinds.[50] The results indicated that normal product use could make lead dust available to children. The deterioration of the vinyl and subsequent availability of lead continued despite washing or cleaning indicating that consumers were vulnerable despite good housekeeping practices.[51]

The vinyl blinds produced a surprising amount of toxic lead dust. The Environmental Protection Agency (EPA) standard limits for lead dust used in risk assessment of homes are 500 $\mu g/ft^2$ for window sills and 100 $\mu g/ft^2$ for floors.[52] In sharp contrast, lead levels over 14,000 $\mu g/ft^2$ were found on some blinds.[53] In Arizona, lead levels in all ten samples exceeded 100 $\mu g/ft^2$.[54] Seven of the ten samples had levels greater than 500 $\mu g/ft^2$.[55] In North Carolina, lead levels exceeded 100 $\mu g/ft^2$ in 45 of the 56 samples.[56] About half of the samples contained greater than 500 $\mu g/ft^2$ lead.[57] The vinyl blind sample with the highest level contained 66,440 $\mu g/ft^2$ lead dust.[58]

Vinyl blinds as a health risk

Lead-containing vinyl blinds represent a potentially significant health risk. Blood levels of lead greater than the 10 $\mu g/dl$ action level triggered the investigations in which

blinds were identified as the source of poisoning. Elevated blood lead levels in exposed children ranged from 17 to 58 μg/dl. A total of 31 lead-poisoned children in three states were investigated in the Consumer Product Safety Commission study. However, the agency estimated that 25 million vinyl miniblinds containing lead are imported into the US each year.[59] Taken together, the data suggests that lead poisoning due to vinyl blinds may be a significant preventable health problem in the US.

Publicity and response

Greenpeace and several other environmental organizations publicized the health risks associated with the vinyl blinds. Greenpeace wrote letters informing all the State Departments of Health in the US about the situation and contacted over 200 retailers. Local TV stations also picked up the story. The Chicago NBC affiliate, WMAQ, purchased ten different brands of vinyl blinds in Chicago and found lead levels between 940 ppm and 11,000 ppm.

Despite the publicity surrounding the health risk, the Consumer Product Safety Commission never issued a product recall of vinyl miniblinds. Instead, the agency entered into a dialog with the Window Covering Safety Council, the trade association of manufacturers. Initially, the industry group suggested that production be altered to meet the 600 ppm level specified for lead in paint under the Consumer Product Safety Act.[60] Despite the well-known toxicity of lead, the Window Covering Safety Council stated that "The industry is undertaking this program voluntarily understanding that there has been only cursory evaluation of the health risks of vinyl blinds to the public."[61]

A standard for lead in vinyl

In response to the trade association, the Consumer Product Safety Commission staff proposed a lower standard of 200 ppm lead in vinyl blinds and urged the industry to reduce lead content to the lowest level possible.[62] The trade association responded that, "The industry will work with the Consumer Product Safety Commission to develop an appropriate specification for vinyl window coverings through an accredited national standards organization, such as ANSI."[63] No specification currently exists.

In a follow-up memo the Consumer Product Safety Commission reiterated the position that lead levels below 200 ppm were technologically feasible.[64] In addition, the Consumer Product Safety Commission reminded the industry group that "... it is the responsibility of each manufacturer/importer to assure that the lead substitutes and other chemicals used in the manufacture of vinyl miniblinds do not present a hazard to consumers."[65]

The Consumer Product Safety Commission action and industry response were carried out quietly with no public attention. The agency never issued a mandatory standard for lead in vinyl blinds despite the 200 ppm level proposed by their own staff. Instead, the agency stated that "Because companies are discontinuing the use of lead, no

standard appears to be needed."[66] Unfortunately, the situation was different on the retail level.

The sale of a product containing lead is tolerated

The Consumer Product Safety Commission instructed retailers to place warning labels on brands known to contain lead but the recommendation was not enforced. Greenpeace found unlabeled, lead-containing miniblinds in Kmart stores across the US several months after the Consumer Product Safety Commission declaration. The lead-containing blinds were sold at deep discounts during the 1996 Labor Day Sale. It appears that vinyl blinds represent the first lead-containing consumer product whose sale was tolerated by governmental authorities, manufacturers, and retailers despite the demonstrated health risks to children.

Legal action in California

The State of California response to lead-containing vinyl blinds was more protective than the actions taken by the Consumer Product Safety Commission. Instead of issuing a recommendation, the state Attorney General, Dan Lungren, and Alameda County District Attorney, Tom Orloff, filed suit against 12 companies that made or sold the blinds since they failed to warn consumers as required by law.[67] The defendants included well-known national chains like Wal-Mart, Kmart, J.C. Penney, and Montgomery Ward & Co.

The problem remains unresolved

The lead content of all vinyl products remains unregulated even though lead poisoning causes irreversible nervous system damage to both children and adults. Cadmium has never been regulated by the Consumer Product Safety Commission despite its well-known carcinogenicity and kidney toxicity. Despite the clear health risk demonstrated by vinyl blinds, a Greenpeace follow-up evaluation revealed that no public agency appeared to be investigating other vinyl products to determine whether they might pose a similar health hazard as the miniblinds. Greenpeace initiated a study of lead in vinyl consumer products and found that vinyl blinds represent the tip of a much larger toxic iceberg.

Appendix III. Regulation of Lead in Vinyl

The adverse health effects of lead prompted a proposal for a specification limit in vinyl blinds. The Consumer Product Safety Commission staff recommended a lead limit of 200 ppm. The proposal was based on a maximum allowable ingestion limit of 15 μg/day lead, the surface area of half a hand of a typical child, and an assumption about vinyl degradation and subsequent availability of lead dust. The authors pointed out that "Staff believes that any ingestion of lead is undesirable because the effects of lead ingestion are cumulative and other sources of lead may be available to children, the staff urges the manufacturers to use the lowest amount of lead below 0.02% that is technologically feasible."[68]

The protection provided by the 200 ppm (0.02%) lead limit is questionable. To calculate the limit, the agency assumed a maximum allowable lead ingestion level of 15 μg/day. This is thirty times higher than the maximum level permitted in the state of California. In order to determine the likelihood of dust ingestion, the Consumer Product Safety Commission confined the exposure pathway to hand-to-mouth behavior. This presumes that the lead dust on blinds is somehow safe unless a child's hand touches them. Unfortunately, instead of disappearing, lead dust probably becomes part of the indoor environment. Failure to consider the fate of high levels of lead-contaminated dust inside a room underestimates the possible exposure and permits calculation of a more lenient specification limit.

The hand-to-mouth exposure scenario provided a method for calculating a maximum dust limit. The agency used anthropometric data to calculate the area of a typical child's hand between 2 and 6 years old. However, instead of using the area of both hands to determine possible dust exposure, the agency used half the area of only one hand. This means that a child might actually be exposed to four times the amount of lead dust the agency staff used in their calculation to determine the "safe" level. The staff then used this area to calculate the maximum dust limit that would maintain ingestion equal to or less than 15 μg/day. The agency proposed a lead dust limit of 3 $\mu g/in^2$, roughly equal to the EPA limit for windowsills of 3.472 $\mu g/in^2$ (500 $\mu g/ft^2$).

Finally, the Consumer Product Safety Commission used an association between total lead content of a vinyl blind and the amount of lead dust produced by a blind to arrive at a specification limit. Since the average total lead content was 6,900 ppm (0.69%) and the average lead dust level among the highest samples was 123 $\mu g/in^2$, an availability factor could be calculated assuming that all blinds degrade in a similar manner. The average dust level was 41 times higher than the suggested dust limit. Therefore, the agency divided the average total lead content of a blind by 41 (6,900/41) to yield 200 ppm lead as the standard.

A more protective specification limit could have been calculated using different assumptions and standards. Simply calculating the specification using the width of a whole

hand instead of half a hand would cut the limit in half to 100 ppm. Performing the calculation using two hands instead of one would have further reduced the limit to 50 ppm. Using the maximum permissible lead ingestion limit of 0.5 μg/day as mandated by California law would lower the specification from 200 ppm to 6 ppm even if only half of one hand was used in the calculation. The irreversible, cumulative health risks posed by lead poisoning warrant a more protective limit for lead in vinyl than 200 ppm.

Appendix IV. Stabilizers in PVC

Polyvinyl chloride (PVC) requires the addition of stabilizers to prevent degradation because it contains chlorine. Small faults in the polymer chain can serve as starting points for degradation. During the obligatory heating steps of PVC processing, chlorine can leave the polymer chain and combine with hydrogen to form corrosive hydrogen chloride which further degrades the polymer. At the same time, double bonds are formed in the polymer. As the process proceeds the polymer loses increasing amounts of hydrogen chloride and forms increasing numbers of double bonds.[69] A positively charged metal can act as a stabilizer by stabilizing bound chlorine and binding free hydrochloric acid, thereby effectively neutralizing it and preventing further damage to the polymer. Common heat stabilizers in PVC formulation include lead and mixed metal soaps containing barium, calcium, zinc, and cadmium, and organotin compounds.

Lead historically has been used as a cheap, effective stabilizer of PVC since the 1950s. From a chemical perspective, it is useful in both rigid and flexible PVC products and in electrical cables due to its electrical properties as demonstrated by its presence in Sega Genesis cables, video cables, computer cables, and headphone cables (Table 1).

Mixed metal soaps like barium/cadmium, barium/zinc, and calcium/zinc act as stabilizers by replacing reactive chlorine atoms with less reactive atoms or groups.[70] In a barium/cadmium soap a carboxylate group substitutes for chlorine which reacts with cadmium forming cadmium chloride. The cadmium chloride then reacts with barium forming barium chloride and regenerating the cadmium metal soap. The other soaps operate in a similar manner. Unfortunately the least toxic metals make the poorest, most expensive stabilizers. Calcium/zinc stabilizers provide less long-term stability than those containing toxic cadmium or lead.[71] To solve this problem, organotins have been introduced as PVC stabilizers. While reasonably effective, the immunotoxicity of some organotins in animals has raised concerns about their effects in humans.[72, 73] Organotins are also known endocrine disruptors.[74]

In addition, the substitution of organotins illustrates a common corporate strategy. When consumer or regulatory pressure threatens a toxic additive, manufacturers can delay regulation and maintain profitability by substituting an additive that has not been rigorously tested for health and environmental impacts. Organotins are poorly characterized and therefore make good candidates for this strategy. By the time the additive is demonstrated to be hazardous, another substitution can be made thereby maintaining both corporate profitability and possibly perpetuating consumer health risks.

Appendix V. Materials and Methods

Lead and cadmium measurements

The total lead and cadmium content of all items was measured using atomic absorption spectroscopy by Stat Analysis, Chicago, Illinois AIHA proficient, NIST/NVLAP accredited. Laboratory work was supervised by Benjamin Ruth, PhD Testing was conducted blind to prevent possible bias introduced by product recognition. Sample preparation proved to be an important determinant of variation. Complete ashing of samples in a Thermolyne 48000 muffle furnace at 480C for two hours helped reduce variation though some sample heterogeneity was observed. Nitric acid, hydrogen peroxide, hydrochloric acid and methylene chloride were reagent or analytical grade. A test tube acid digestion lead preparation procedure (AOAC 5.001-3) was combined with an organic digestion using analytical grade methylene chloride (NIOSH9076). Measurements were performed using a Varian SpectrAA200 atomic absorption spectrophotometer. All appropriate laboratory QA/QC procedures regarding standard curve tolerances were followed for all samples including use of blanks and matrix spikes every 10 samples and NIST reference standards.

Acid extraction tests

Acid extractability was performed using procedures developed by the Consumer Product Safety Commission.[75] Studies were conducted by Stat Analysis, Chicago, Illinois. A test portion of plastic material was mixed with a 50-fold mass of 0.07 N hydrochloric acid and agitated for one hour at 37C in the dark. The material was re-extracted for two hours and then a third time for three hours. All three fractions were combined and analyzed for lead content.

Accelerated aging tests

Accelerated aging tests were performed using procedures developed by the Consumer Product Safety Commission.[76] Studies were conducted by personnel at the Environmental Quality Institute at the University of North Carolina-Asheville, AIHA, ELLAP accredited. The project was supervised by Richard Maas, PhD, associate director of the Institute.

A weatherometer was constructed according to specifications given in ASTM G53 without the condensation features and validated by lab personnel for temperature stability and illumination.[77] Even though moisture is a significant agent in degradation of materials, dry conditions were used in these aging studies to permit observations under milder, more realistic conditions. Natural and accelerated aging can be correlated if sufficient numbers of variables are compared in both methods.[78] Ultraviolet lights identical to those used in the UVCON brand weatherometer were purchased from Atlas

Electric Devices Company, Chicago, Illinois. The wavelength output in the 295-365 nm region provides excellent correlation with natural sunlight and outdoor exposure.

Samples were exposed to alternating cycles of six hours duration. The heat and light cycle was conducted at 50C under ultraviolet light illumination in the UV-A region. The alternate cycle was conducted at room temperature without illumination. Samples were tested in triplicate in a single blind design to prevent possible bias caused by product recognition among lab personnel. Samples were wiped at weekly intervals. One Pace Wipe was used to wipe each sample ten times. Wipes were digested and analyzed to yield lead and cadmium content per area wiped.

Lead and cadmium determinations were performed by graphite furnace atomic absorption spectrophotometry (GFAAS) using two Thermo-Jarrel-Ash Model 11 or Model 12 spectrophometers with TJA Model 774 graphite atomizers. All appropriate laboratory QA/QC procedures regarding standard curve tolerances and standard additions were followed for all samples.

Study design

Vinyl items purchased in Chicago area national chain stores were tested for total lead at Stat Analysis, Chicago, Illinois. Stores included Disney, Kmart, Target, Toys R Us, Uncle Dan's, Wal-Mart, and Warner Bros. In addition to information provided by product labels, all items containing lead were verified by the laboratory as PVC plastic by the Bellstein test for chlorine. Products containing above 100 ppm lead were also tested for cadmium content. A representative sample of 19 lead-containing items was selected for purchase in other cities. Not every item was found in every city. The sample included soft vinyl of various thickness, PVC-covered cable, and rigid PVC. Toys, clothing, household items, and cables were all included in the sample. Cadmium testing was restricted to items from Chicago, Los Angeles, San Francisco, and Montreal, Canada to control cost. A smaller sample of 7 products was submitted in triplicate for accelerated aging experiments as described above. The sample included soft and rigid PVC products designed for use by children. Most of the items submitted for the accelerated aging study were purchased in California.

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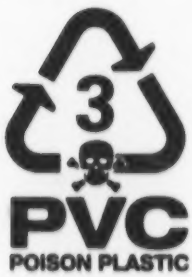
Lead and cadmium are not the only toxic risks associated with PVC. PVC is the most environmentally-damaging plastic. The PVC lifecycle—its production, use and disposal—results in the release of toxic, chlorine-based chemicals. These toxins are building up in the water, air and food chain. The result: severe health problems, including cancer, immune system damage, and hormone disruption. No one can escape contamination. Everyone, everywhere, has measurable levels of chlorinated toxins in their bodies.



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Determination of the Composition and Quantities of Phthalate Ester Additives in PVC Children's Toys

Summary

PVC (polyvinyl chloride or vinyl) is widely used in toys and other children's products. For soft applications, such as toys designed for chewing ("teethers"), softeners or plasticisers are added to give the desired flexibility. Although a range of chemicals are used as softeners, phthalate esters (phthalates) are by far the most commonly used.

Phthalates do not bind to the PVC, remaining present as a freely mobile and leachable phase in the plastic. As a consequence, phthalates are continuously lost from soft PVC over time. Contact and pressure, such as that applied during teething or play, can increase the rates at which these chemicals leach from the plastic.

Children in contact with soft PVC toys may, therefore, ingest substantial quantities of phthalates during normal play, especially from toys specifically designed to be chewed. This is of concern as phthalates are known to present a number of hazards. Although acute toxicity appears to be low, phthalates have been shown to cause a range of adverse effects in laboratory animals following longer exposure, including damage to the liver and kidney and, in some cases, effects on the reproductive tract.

The limited research available to date on the composition of phthalates in PVC toys has raised concerns over the potential for exposure of children to these chemicals. Despite this, manufacturers do not provide information on the types or quantities of additives present in toys. Greenpeace was interested, therefore, to obtain a range of typical soft PVC toys from a number of countries, particularly those designed to be chewed, and to determine the types and quantities of plasticisers present.

A total of 71 toys were purchased, drawn from 17 countries, the majority of which (63) were PVC or had PVC sections. In almost all soft PVC toys analysed, phthalates comprised a sizeable proportion (most frequently 10-40%) of the total weight of the toy. Although historically the most commonly used phthalate was DEHP (di(2-ethylhexyl)phthalate), the most frequently identified, and generally most abundant, phthalate in the current investigation was the isomeric form DINP (diisononyl phthalate). Of the 63

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PVC toys analysed, 40 contained DINP as the predominant phthalate, compared to only 8 for DEHP. DEHP was also present as a minor component of many of the toys containing DINP, perhaps as a contaminant in the DINP. Of the 8 non-PVC toys analysed, only one contained any detectable phthalate, and then only in trace quantities (possibly as a contaminant from the PVC in which it was packaged).

Although less well researched than DEHP, DINP shows similar toxicological properties in laboratory animals. Effects recorded include liver and kidney disorders, damage to the reproductive tract, increased incidence of certain forms of cancer and diverse effects on development and metabolism. More recently, research has revealed that DINP, along with some other phthalates, shows weak activity as a mimic of the hormone estrogen in human cell lines. When purchased for laboratory use, DINP is labelled with a number of hazard phrases, including "harmful by inhalation, in contact with skin and if swallowed", "possible risk of irreversible effects" and "may cause cancer". In contrast, toys containing up to 40% by weight DINP in a readily leachable form are frequently labelled "non toxic".

A number of other compounds were identified in some of the toys, generally at lower but significant concentrations. DBP (dibutyl phthalate) and BBP (butylbenzyl phthalate), found in several toys, are known to be particularly hazardous. The estrogenic chemical nonylphenol was isolated from 13 toys, while 2 toys were found to contain the fungicide Fungitrol 11 (Folpet).

The rates at which chemicals leach from soft PVC were not determined in this study. Nevertheless, the presence of these chemicals in such quantities in toys designed to be chewed by babies and young children, along with published evidence that such additives are hazardous and can leach from PVC toys, raises serious concerns. The Danish EPA has recently demonstrated that the leaching of phthalates, particularly DINP, from teething toys can be substantial. This has been supported by similar studies in other countries and has led, in some cases, to recommendations that certain toys be withdrawn or even that the use of soft PVC in toys for young children should be discontinued.

The study carried out by Greenpeace has demonstrated that phthalates, particularly DINP and DEHP, are widely and abundantly used in high contact children's toys. Their use represents a significant potential for exposure of children to chemical hazards, of particular concern during sensitive periods of development. Although it is practically impossible to make accurate predictions of dose, exposure to such hazards is clearly unacceptable. The only way to avoid direct intake of phthalates is to eliminate the use of PVC in all soft toy applications.

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5. According to Greenpeace, phthalates are carcinogenic and the proof is that toy manufacturers withdrew the plasticizer DEHP after the National Cancer Institute identified it as cancer-inducing.

Toy manufacturers voluntarily withdrew DEHP in 1986 after it was shown that large doses of it caused increases of microbodies in the liver called peroxisomes, leading eventually to tumors. Later studies have shown however that the same chemicals administered to non-rodent species, such as marmosets, guinea pigs and humans, do not produce the same effect, and DEHP is being rehabilitated for use as a plasticizer. For example, in July 1990 the European Commission stated that DEHP should no longer be classified as carcinogenic or an irritant.

6. According to Greenpeace, estrogen-mimicking properties demonstrated by vinyl are to blame for reduced sperm counts in men.

The largest and most authoritative study of sperm counts in American men has been conducted by Dr. Harry Fisch at the Columbia-Presbyterian Medical School over a 25-year-period. Looking at 1,283 men in New York, Minnesota and Los Angeles, the study found no decrease in sperm counts and in fact found a major increase among New York men.

7. Greenpeace points out that some of the additives used in the manufacture of PVC, principally heavy metal stabilizers, are highly toxic.

No heavy metal stabilizers, including lead, are used in toys. None.

8. Greenpeace asserts: "...there appears to be no compelling reason for the toy manufacturers to continue using PVC in its production processes." It then goes on: "...we realize that product safety is a critical concern for the toy manufacturers and would encourage ICTI to conduct a thorough safety investigation of any alternative material in terms of cracking and breaking, toxicity and leachability of additives (if necessary for the material), and life cycle hazards (production, use and final disposal)."

The concerns set forth by Greenpeace are compelling reasons to CONTINUE using vinyl in toy manufacture. Vinyl does not crack or break. It is non-toxic. Its life cycle has been found to be more environmentally friendly than suggested alternative materials.

In selecting vinyl for some toy production, we have done precisely what Greenpeace suggested on an earlier occasion: "...encourage manufacturers to enact a materials policy that seeks out appropriate materials with the least environmental impact possible." Vinyl fits the bill.

Toy Manuf's Assn (position paper)

7/97

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News from CPSC

U.S. Consumer Product Safety Commission
Office of Information and Public Affairs Washington, D.C. 20207

For Immediate Release
October 9, 1997
Release # 98-008

Contact: Kathleen Begala
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CPSC Releases Lead and Cadmium Test Results on Vinyl Products

WASHINGTON, D.C. - Greenpeace released a study today alleging that hazardous levels of lead and cadmium are present in many popular vinyl children's products. Testing by the U.S. Consumer Product Safety Commission (CPSC) does not support this conclusion.

CPSC takes action when it learns that products contain hazardous levels of lead. However, CPSC testing found that seven of the 11 vinyl products in which Greenpeace found high levels of lead had no or only trace levels of lead. CPSC conducted further analysis on the four other vinyl products and found two are not hazardous because exposure is not likely, and testing on two is incomplete. Children's health is at risk when they are exposed to hazardous levels of lead. This exposure occurs through ingestion or inhalation.

Of the 11 products, CPSC found eight had no or only trace levels of cadmium and one was not hazardous because exposure is not likely. Testing on two of the products is incomplete.

Using CPSC's experience with vinyl miniblinds, Greenpeace asserts that toxic dust will inevitably be released when vinyl products deteriorate. CPSC staff found that vinyl miniblinds do deteriorate when continuously exposed to sunlight and heat. However, CPSC experts do not believe that the vinyl products tested by Greenpeace will deteriorate because they are not exposed to the same extent of sunlight and heat as the vinyl miniblinds.

CPSC has most recently identified and taken actions to reduce or eliminate the risk of lead poisoning from a number of children's products and consumer products in which lead was accessible to children. These included imported crayons, imported non-glossy vinyl miniblinds, playground equipment and children's jewelry.

CPSC is continuing to evaluate the information provided by Greenpeace and will take action as appropriate.

The U.S. Consumer Product Safety Commission protects the public from unreasonable risks of injury or death from 15,000 types of consumer products under the agency's jurisdiction. To report a dangerous product or a product-related injury and for information on CPSC's fax-on-demand service, call CPSC's hotline at (800) 638-2772 or CPSC's teletypewriter at (800) 638-8270. To order a press release through fax-on-demand, call (301) 504-0051 from the handset of your fax machine and enter the release number. Consumers can obtain this release and recall information at CPSC's web site at http://www.cpsc.gov or via Internet gopher services at cpsc.gov. Consumers can report product hazards to info@cpsc.gov. To establish a link from your web site to this press release on CPSC's web site, create a link to the following address: www.cpsc.gov/cpscpub/prerel/prhtml98/98008.html.

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Review of U.S. Consumer Product Safety Commission October 9, 1997, News Release

by Dr. Richard P. Maas and
Dr. Steven C. Patch

10/9/97

University of North Carolina at Asheville
Environmental Quality Institute

As experienced and nationally-recognized researchers on lead exposure potential from various consumer products, and having recently completed testing for lead and cadmium exposure potential in various children's vinyl products, we offer the following observations and comments related to today's new release by the CPSC.

1. Apparently only single samples of just 11 products were tested. This is far insufficient scope to accurately evaluate the much more extensive research conducted by Greenpeace and the Environmental Quality Institute (EQI).

2. CPSC apparently found lead above trace levels in four of the 11 (36%) products they tested. From a public health perspective, this may be viewed as a high percentage and does not seem to be in conflict with Greenpeace's finding of lead over 100 parts-per-million (ppm) in 28 out of 131 products (21%). It is possible that lead contamination may be sporadic across these vinyl products types. Thus, it is not surprising that CPSC, using only single samples, might find high levels of lead in only four of 11 products where Greenpeace found elevated lead levels. Conversely, it is likely that high lead levels might be found in other samples of products which were previously observed to be lower in lead. It is difficult to evaluate the CPSC statements without knowing what they mean by "trace levels."

3. Apparently three of the 11 products (27%) tested had cadmium levels above trace amounts. Again, for reasons noted above, this would not appear to be in conflict with the Greenpeace findings and should probably be properly interpreted as a relatively high incidence of cadmium contamination.

4. The CPSC has apparently done no testing of these children's vinyl products for

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the release of lead and cadmium dust resulting from sunlight exposure. Rather they simply suggest that this is not a problem because the products are not exposed to the same amount of sunlight as miniblinds, which released large amounts of lead. We find this conclusion particularly puzzling given that:

a. The children's backpackets, raingear, tent poles, and beach gear we tested were intended for outdoor use without the benefit of a glass barrier which absorbs most UV light as in the case of miniblind exposure.

b. We found relatively large amounts of lead released, in some of the products tested, after simulated ultraviolet light exposure.

c. In at least one of the products tested, levels of lead and/or cadmium were available on the product surface even before we began the simulated sunlight exposure tests.

Given the previous experience with vinyl miniblinds, where lead was not released until after sunlight exposure, but then released in very large amounts, it would appear highly imprudent to dismiss these children's products as significant sources of lead and cadmium exposure without at first at least conducting sunlight exposure tests similar to the miniblind tests, particularly in the face of independent laboratory sunlight tests by the EQI indicating a significant exposure problem.

In summary, it appears that the CPSC has gone to extraordinary lengths to draw negative conclusions from a very small study that itself appears to indicate the presence of significant lead and cadmium exposure potential.

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14 October 1997

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Washington, D.C. 20207

Dear Ms. Brown

I have been following the events that ensued after the release of the Greenpeace report on lead in vinyl products, and I must say I was stunned and dismayed by CPSC's response. The CPSC Press Release contained no data and sought to minimize what is surely a serious problem. I will tell you frankly that when I read that four samples of twelve were still being analyzed, I read that as saying they confirm the Greenpeace analysis. If that is true (and if not I don't know why you would release results until all analyses were done) the press release was worse than misleading, it was intellectually and factually dishonest.

If you wish your agency to be taken seriously it is incumbent upon you to provide the methods and results of your analyses so impartial experts can make a determination if your interpretation is accurate. Greenpeace has done so. Until and unless you do likewise, you should not make conclusory statements to the public about an important public health issue.

You are a public health agency, not a public reassurance agency. I'm afraid that this was not CPSC's shining hour.

Sincerely yours

David Ozonoff, MD, MPH
Professor of Environmental Health
Chair, Department of Environmental Health

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State of North Carolina
Department of Environment
and Natural Resources
Division of Environmental Health

James B. Hunt, Jr., Governor
Wayne McDevitt, Secretary
Linda C. Sewall, Director

NCDENR
North Carolina Department of
Environment and Natural Resources

October 15, 1997

The Honorable Ann Brown
U.S. Consumer Product Safety Commission
4330 East-West Highway
Bethesda, MD 20814

Dear Ms. Brown:

As you may be aware, North Carolina was one of the states that helped to identify vinyl miniblinds as a potential source of childhood lead poisoning. In our recent publication, "Childhood Lead Poisoning and Vinyl Miniblind Exposure" (*Archives of Pediatrics and Adolescent Medicine*), eight cases of childhood lead poisoning were identified in North Carolina over a six-month period whose predominant source of lead exposure was from vinyl miniblinds.

Research by the CPSC has indicated that vinyl miniblinds, when exposed to sunlight and heat, break down and release lead additives as dust on the surface of the blinds. Children can then become exposed through normal hand-to-mouth activity after touching or chewing on the blinds. North Carolina issued a health warning in March 1996 similar to the warning issued by the CPSC and specifically recommended that parents and child care operators remove vinyl miniblinds purchased prior to July 1996.

Unfortunately, this issue is far from resolved as we have identified several other miniblind-related cases since the completion of our investigation in August 1996. Just last week a child was identified whose blood lead level is 22 *ug*/dL and whose only apparent source of exposure was an extensively chewed set of vinyl miniblinds; the surface of which was covered with dust that contained a lead concentration of more than 35,000 *ug*/ft^2 (photo enclosed). These blinds were purchased well before the CPSC's hazard warning was issued in June 1996 (which has helped tremendously to restrict the availability of lead-containing vinyl miniblinds). However, it has been our experience that older lead-contaminated vinyl miniblinds continue to be used by families with young children as a product recall has not been issued by your agency.

While the CPSC issued a public warning and came to a voluntary agreement with the Window Covering Safety Council to ensure that vinyl miniblinds will no longer be manufactured using lead stabilizing additives, retailers may continue to legally sell lead-containing vinyl miniblinds so long as they are labeled as such.

Recent information published by Greenpeace on lead levels found in children's products raises new questions about potential vinyl-related sources of lead exposure. The analysis was

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conducted by a respected and certified laboratory, the Environmental Quality Institute (EQI), at the University of North Carolina in Asheville, and indicates that lead and cadmium from these products are potentially available for ingestion by children. While in many cases these products may not be exposed to constant sunlight and heat, conditions will vary such that many of these products will be subject to degradation.

I am concerned that the CPSC's hurried response (press release #98-008) and the testing of only 11 products is inadequate to judge the potential hazard from these vinyl products. From a public health perspective, the public, state health agencies, manufacturers, and retailers need to be warned of the potential hazard and a thorough investigation of vinyl children's products, including dust sampling and analysis should be initiated. If the EQI results are independently substantiated, a recall of these vinyl products as well as older vinyl miniblinds may be in order.

I appreciate your assistance with these matters and look forward to working with the CPSC to protect children from potential sources of lead poisoning in the future.

Sincerely,

Ed Norman
Children's Environmental Health Branch

Enclosure

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ENVIRONMENTAL QUALITY INSTITUTE

UNCA, ONE UNIVERSITY HEIGHTS • ASHEVILLE, NC 28804-3299
LABORATORY (704) 251-6895 • FAX: (704) 251-6913

Memorandum 10/13/97

To: Dr. Joe Di Gangi
From: Dr. Richard Maas and Dr. Steven Patch
Subject: CPSC Press Release on 10/9/97

When the Consumer Products Safety Commission (CPSC) issued a press release on 10/9/97 regarding Greenpeace's investigation of lead and cadmium risks from children's vinyl toys, we wrote a brief review discussing possible misrepresentation of their own data and inappropriate conclusions. Unfortunately, at that time, CPSC had not made their data and methodology public and it was not possible to fully evaluate the information contained in the press release.

Since then we have learned that CPSC utilized an inappropriate chemical analysis method, which would be expected to underestimate actual lead and cadmium levels in vinyl products Specifically, according to their laboratory, they analyzed their samples by AOAC Method 974.02, which was developed for analyzing lead in paint. However, because paint is essentially an inorganic matrix, no sample ashing step is including in the protocol. For substances such as polyvinyl chloride (PVC), which is an organic compound, a sample ashing step to destroy the organic chemical matrix must be included, or else only part of the lead and cadmium in the vinyl may be released and observed. We documented this in our own laboratory and found that without sample ashing, lead concentrations were significantly underestimated.

It should be noted that both the Stat Analysis laboratory and the EQI laboratory used the appropriate sample ashing analysis methods and independently found very similar results, while the CPSC laboratory, which did not use ashing, obtained significantly lower lead and cadmium concentrations in about one-half the products.

We have no reason to believe that the CPSC purposefully used a method which would underestimate actual lead and cadmium levels in the vinyl products, but the fact is that this could easily explain the moderate level of discrepancy between the CPSC results as opposed to those of the EQI and Stat Analysis laboratories.

We would like to reiterate our comments in our earlier review of the CPSC press release that it is highly imprudent to dismiss these children's products as significant sources of lead and cadmium exposure without at first at least conducting sunlight exposure tests similar to the miniblind tests. The degradation properties of vinyl are not well known at this point and it would be inappropriate to declare that there is a minimal risk until careful, thorough studies on these products have been completed.

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TOTAL P.02

Mount Sinai

The Mount Sinai Medical Center
The Mount Sinai Hospital
Mount Sinai School of Medicine

One Gustave L. Levy Place
New York, NY 10029-6574

Department of Community Medicine
Box 1043

October 15, 1997

Ms. Ann Brown
Chair, Consumer Products Safety Commission
Washington, DC 20207

Dear Ms. Brown:

As requested by Greenpeace, I reviewed their report, Lead and Cadmium in Vinyl Children's Products, and found no reason to question its results. The laboratory that conducted the analyses used methodologies acceptable to the EPA and other federal agencies. The findings seemed to have important public health implications warranting their release. I view the Greenpeace findings as a warning clearly calling for further study and confirmation by other investigators.

I was contacted by reporters after the release of the study and was disappointed to learn from them that the Consumer Product Safety Commission had attempted to rebut or refute the Greenpeace findings. The reporters asked me to respond to CPSC's unpublished numbers and conclusions, which of course I could not to. I have subsequently learned that the CPSC has done a limited number of analyses, some of which appear to corroborate the Greenpeace findings. When the CPSC studies are complete and reported I would be happy to receive a copy so that I might evaluate them.

If the CPSC actions were simply an effort to discredit the Greenpease report I am disappointed. The public health is best protected by every effort to report new findings completely and respond to them objectively.

I look forward to hearing from you.

Sincerely,

Michael McCally

Michael McCally, MD, Ph.D.

MM:oa

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World Health Organization
Collaborating Centre in

OCT-15-1997 15:04

GREENPEACE

October 14, 1997

Ann Brown, Chair
Consumer Product Safety Commission
Washington, D.C. 20207

Dear Ms. Brown,

We believe it is essential that the Consumer Product Safety Commission (CPSC) issue a statement of clarification regarding vinyl children's products and warn the public that reputable scientists and experts in the field of childhood lead exposure believe that heavy metal exposure from these products presents an avoidable risk that ought to be of concern to parents.

On Wednesday, October 8, 1997, the Consumer Product Safety Commission (CPSC) issued press release #98-008. The press release stated that testing of 11 vinyl products by the CPSC "does not support" the findings of the Greenpeace report, "Lead and Cadmium in Vinyl Consumer Products". CPSC staff repeatedly emphasized this point in press interviews.

The circumstances surrounding the release of the CPSC statement are troubling. Greenpeace had provided senior CPSC staff with an embargoed copy of the Greenpeace report in advance to enable appropriate comment. However, CPSC staff chose instead to release testing information without the actual data from an incomplete investigation that was hurriedly initiated upon receipt of a leaked copy of the Greenpeace report. The press statement was characterized in a way which tended to dismiss the Greenpeace findings, rather than acknowledge their significance.

We have now learned that the CPSC incorrectly measured lead and cadmium levels in vinyl plastic and then distorted the reporting of its own data. It is thus unconscionable that you let the Commission's initial response stand.

The CPSC measured lead in vinyl with a procedure that was designed to measure lead in paint. The independent labs commissioned by Greenpeace used a procedure designed for determining lead in vinyl. The Environmental Quality Institute (EQI) and Stat Analysis have documented that paint procedures underestimate the lead content of vinyl due to the physical differences between paint and vinyl. The CPSC probably underestimated lead and cadmium levels in several vinyl samples because it used the wrong measurement procedure.

The CPSC press release referred to data without giving any numbers. Greenpeace has learned why. The CPSC data shows four vinyl products that exceed the agency's own legal recall level for lead of 600 ppm. No reference was made to these products in the

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CPSC press release even though the agency measured lead levels from 810 ppm to 6,300 ppm. The products include a Gemini modular phone cord cable, a Barbie Slumber Tent Pole, a Looney Tunes Hackey Sack, and a Looney Tunes umbrella. In addition, the CPSC failed to report that their results for these hazardous products closely matched those reported by Greenpeace. The Commission ignored their own data which indicated that hazardous levels of lead are present in vinyl products.

The CPSC data also showed that cadmium was undetected in the few products that the agency tested. Unfortunately, a relatively high no-detect threshold of 50 ppm cadmium was used by the agency. If this is taken into account, the CPSC and Greenpeace data appear to match quite closely.

Finally, the CPSC press release dismissed the hazard posed by release of lead and cadmium from vinyl children's products during degradation in the light. The CPSC asserted that vinyl children's products would get less sunlight than vinyl miniblinds. In contrast to asserting an opinion, Greenpeace commissioned the EQI to conduct a thorough scientific study of products intended for outdoor use. The EQI used the CPSC's own protocol to demonstrate that hazardous amounts of lead and cadmium were released during deterioration of vinyl children's products.

For example, a Barbie backpack purchased at Kmart in nine cities contained 236 ppm - 627 ppm lead and released more than 35 ug of lead and 23 ug of cadmium to its surface during deterioration in the light. These levels are two times higher than the CPSC's own lead exposure standard of 15 ug/day. In California where the backpack was purchased, the lead and cadmium amounts released by the backpack are 70 and 460 times higher than the maximum permissible exposure levels under Proposition 65. This product, along with many others, remains on the shelves of retail stores today. This is simply unconscionable.

The Greenpeace report differs significantly from the CPSC press release. The Greenpeace report discloses the results of a seven month investigation that included 131 product tests followed by testing in 10 major US cities along with experiments conducted by two independent laboratories. The data demonstrates that lead and cadmium are available for ingestion by children. The results were submitted to peer review by a distinguished panel of scientists and physicians. The Greenpeace findings on lead and cadmium further support proposals for moving away from using vinyl in children's products.

In contrast, the CPSC performed a few tests and found four vinyl products that exceeded the agency's own recall level for lead in consumer products. Despite its mandate to protect public health, the CPSC chose not to report this data and the fact that it had partially confirmed Greenpeace findings. Instead, the CPSC issued a press release designed to invalidate the Greenpeace report.

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GREENPEACE

We deem it inappropriate that the CPSC chose to publicly cast doubt on the validity of our work. Either the CPSC should have simply released its data and allowed that it confirmed some of the Greenpeace findings, or the agency should have stated that an investigation was ongoing and no scientific conclusions could be drawn.

It was disingenuous and dangerous to publicly cast doubt on the validity of the Greenpeace investigation. For example, Greenpeace revealed the widespread sale of a piece of vinyl Kentucky Fried Chicken designed to be placed in children's mouths which contained both lead and cadmium. Experiments conducted by Stat Analysis revealed dangerous levels of lead would be released by the chicken if only one-thousandth of an ounce was swallowed.

We have been invited to meet with your technical staff to discuss the differences in data and chemical analysis. We are eager to do so. However, we remain disappointed and concerned that the Commission's public pronouncements on the matter carelessly offered false reassurances to the public at a time when concern should be elevated.

We await your earliest response as to whether the Commission will revise its public statement to accurately convey the essence of its own investigation.

Sincerely,

Joseph Di Gangi, PhD
Scientist, Toxics Campaign
Greenpeace USA

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San Francisco Examiner

Study finds high lead in vinyl kids' toys

Many household items said to exceed safety levels

By Jane Kay
EXAMINER ENVIRONMENTAL WRITER

Popular vinyl toys, including Barbie's backpack and Tweety's rain hat, contain levels of lead apparently exceeding California health standards, researchers found.

Scientists tested 131 products, including toys, video cables, phone cords, place mats and other household items. Of those, two dozen were tainted with lead above a level recommended by the U.S. Consumer Product Safety Commission when it first found the toxic metal in vinyl mini-blinds two years ago.

Greenpeace, which sponsored the research, released the data Thursday in a study titled "Lead and Cadmium in Vinyl Children's Products."

At the Greenpeace's request, a Chicago laboratory, Stat Analysis, tested lead and cadmium in polyvinyl chloride, or PVC, products sold across the country. The University of North Carolina's Environmental Quality Institute estimated exposure levels and found that many products appeared to exceed safety levels set by California's Proposition 65, the Safe Drinking Water and Toxic Substances Act of 1986.

"The conclusion we're coming to is that PVC is not a good material to be making products that children will come in contact with,"

[See TOYS, A-18]

FRONT PAGE!
10/9/97

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◆ TOYS from A-1

Study finds high lead in vinyl toys

said Richard Maas, associate director of the university's institute.

"PVC by its nature is an unstable plastic. PVC produces chlorine as it ages, and manufacturers have to use stabilizers like lead, cadmium and organotin to absorb it."

The institute conducts research on lead in faucet fittings, submersible pumps, calcium supplements and, more recently, brass water meters.

Deputy Attorney General Susan Fiering, who specializes in Prop. 65 cases, said, "This is of interest to us. ... We have not received any notice of the study yet. We'll certainly look into it."

As a result of the study, health officials are calling on manufacturers and the government to curtail exposures to children.

Critics have said the Consumer Products Safety Commission hasn't taken an aggressive enough stance in setting standards or testing products.

"I think the (commission) should wake up and pay more attention to this," said Dr. Howard Hu, associate professor of occupational and environmental medicine at Harvard School of Public Health.

"One year we read about lead in crystal getting into wine, then vinyl mini-blinds and lipstick and now in children's toys," said Hu.

"The lesson to be learned is that we should be more systematic in finding potential sources of lead at home and at work, and mobilize the consumer and regulatory resources to change things."

Mark Sofman, manager of industry affairs for the Vinyl Institute, a trade group, said he couldn't comment on the study until he had seen it.

"We think we make a great product," Sofman said. "Over the past years, we've embarked on a number of ways to improve overall environmental performance."

Toys R Us is one of the retailers that sells some of the toys in the study. Rebecca Caruso, the company's vice president of corporate communications, said, "All of our toys meet U.S. and world standards. We follow the advice of our suppliers, and they follow the experts."

On Wednesday, representatives of the Consumer Product Safety Commission said they would continue to review results of the study. But in their preliminary examination, they said they found fewer products contained lead than what the Chicago lab had reported.

"It's really kind of early to know how they did the study and why they found lead in some products and we didn't," said Ron Medford, assistant executive director for the commission's hazard identification and reduction unit.

Medford said that toys and other PVC products wouldn't degrade and release lead as readily as mini-blinds, which are permanently in the sun. In addition, most outdoor toys are made of hard plastic, not PVC plastic, he said.

"But if we were to find another PVC product with lead at levels that created a risk to children, the agency would take action," Medford said.

Lead poisoning is the No. 1 environmental problem facing the nation's children. In recent years, lead levels have fallen as regulations have curbed lead in paint, gas and other products.

Officials estimate 1 million children are still exposed to unsafe levels of lead, however.

Lead is insidious. At very low levels — and with no visible symptoms — it can stunt growth and cause mental retardation and behavioral problems. Cadmium is a carcinogen that can also damage the kidneys.

In 1996, Arizona health officials discovered that PVC mini-blinds were shedding lead dust and causing health problems in children. The discovery prompted the safety commission to recommend a lead standard of 200 parts per million for mini-blinds.

The commission signed an agreement with distributors and retailers to enforce the voluntary standard, but hasn't adopted a formal regulatory standard into law or recalled any mini-blinds.

The California attorney general immediately told retailers to warn customers or stop selling the mini-blinds. The state also filed a lawsuit against about 15 stores, charging them with selling mini-blinds that violate Prop. 65 lead standards without warning customers. The stores subsequently agreed to sell lead-free mini-blinds.

LEAD, CADMIUM LEVELS

A consumer survey found lead and cadmium in vinyl toys, clothing, backpacks, cables and household items above safety standards.* The levels, in parts per million:

Item	Lead	Cadmium
AT&T 25-foot phone line cord	213	65
Barbie backpack	372	75.7
Barbie Slumber play tent pals	6,105	14.6
2-pound barbell vinyl cover	7,050	12.4
Barth & Dreyfuss place mat	308	6.2
Columbia youth parka	22,550	47.9
Dimples doll stroller	7,115	22.6
Disney Minnie Totes key ring	1,430	6.1
Gemini computer printer cable	5,765	18.1
Gemini phone cord	865	15.3
Gemini video 3-foot coaxial cable	7,505	10.3
Gloria Vanderbilt place mat	605	12.0
Kentucky Fried Chicken toy	207	344.0
Looney Tunes hackey sack	1,010	ND
Looney Tunes umbrella	617	27.0
Medela breast milk cooler	375	29.3
Pacific Kids purse	349	104.8
Philco headphones cable	3,490	52.4
Philco in-ear headphones cable	3,770	11.0
Sega controller video-game cable	4,100	17.4
Springs Bath shower curtain	864	105.6
Totesbise cosmetics pouch toy	392	162.0
Tweety rain hat	4,060	35.4
Tweety tote bag	459	228.6

*The federal Consumer Product Safety Commission staff has recommended limit for lead in vinyl is 300 parts per million. California's Proposition 65 regulates cadmium at one tenth the level set for lead. The Consumer Product Safety Commission doesn't regulate cadmium.

SOURCE: Vital Analysis, Chicago

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TESTING TOYS

ome of the products that ceeded, or were near, the ad and cadmium levels etermined to be hazardous y the government, according Greenpeace tests.

- 101 Dalmatians Backpack
- Barbie Backpack
- Disney Minnie Totes Key Ring
- Warner Brothers Space Jam Placemat
- Pacific Kids Purse
- Tweety Rainhat
- Tweety Totebag
- Barbie Slumber Tent Pole
- Kentucky Fried Chicken Toy
- Toteables Cosmetics Pouch
- Dimples Doll Stroller
- Looney Tunes Umbrella

THE WASHINGTON POST

Greenpeace Cites Vinyl as Hazard in 28 Toys

Consumer Product Safety Commission, Manufacturers Dispute Tests' Scientific Accuracy

By Beth Berselli
Washington Post Staff Writer

Greenpeace, long known for its splashy environmental protests, is getting into the consumer watchdog business. Yesterday the group released a list of 28 vinyl children's products, including Barbie accessories, a Looney Tunes umbrella and a Disney key ring, that it says contain dangerous levels of lead and cadmium.

The U.S. Consumer Product Safety Commission, which last year persuaded makers of vinyl miniblinds to voluntarily remove their lead-heavy products from the market, promptly said its own testing does not support Greenpeace's conclusions. Toy manufacturers and retailers also criticized the group's findings as scientifically inaccurate, with the head of the industry's association calling the new report a "desperate attempt on the part of Greenpeace to catch parents' attention."

"Here we have a lot of people who are trying to raise funds and reestablish themselves," said David Miller, president of the New York-based Toy Manufacturers of America. "It's bad business to make dangerous toys—we just don't do it."

The CPSC discounted the exposure risk, saying that unlike the miniblinds, products such as backpacks and umbrellas aren't likely to be exposed to the direct sunlight and heat that caused elements in the miniblinds to deteriorate and thus expose children to harmful levels of lead.

At issue is a kind of plastic called polyvinyl chloride, or PVC. Greenpeace began investigating PVC's effects on consumers this summer, after three states reported that vinyl miniblinds had caused lead poisoning in some children.

At a news conference in Washington yesterday, Bill Walsh, director of Greenpeace's toxics campaign, called PVC "the worst plastic for the environment." The group said the production and burning of PVC produce a chemical called dioxin, which has been linked by scientists to cancer and developmental and reproductive damage.

PVC in its pure form is a brittle, hard to manipulate substance, so manufacturers must add various chemicals to it. These additives don't bind to the plastic, however, and can therefore be released when, for example, a child handles or sucks on a toy made of the plastic.

Greenpeace identified two main types of hazardous additives—"stabilizers," such as lead and cadmium, and "plasticizers," such as a group of chemicals called phthalates. The stabilizers are added to keep the PVC from degrading, while the plasticizers make it soft.

Elevated levels of lead in the blood have been linked to learning disabilities, brain damage, growth retardation and behavioral problems. Scientists say cadmium may cause kidney damage and has been associated with some cancers. Phthalates have been linked to liver and kidney disorders, damage to the reproductive tract, and increased incidence of certain kinds of cancer in experiments with laboratory animals.

Experts, however, disagree on PVC's human health hazard. While the Greenpeace researchers portray the plastic as a widespread threat, others in the scientific community say the amount of lead or cadmium in PVC is minimal.

"There's not a reasonable exposure pathway where you expect someone to be exposed to a toxic level of these materials, even if it's there," said Tim Pickering, a chemistry professor at Virginia Tech.

Greenpeace examined the plasticizers in a study released in September. That report found that several soft PVC products, including babies' teething rings made by such companies as Gerber Products Co. and Hasbro Inc., contained high levels of phthalates.

The group took its investigation one step further with the new lead and cadmium study. As part of a seven-month effort, Greenpeace examined 131 popular toys and other children's products purchased from retail stores such as Toys R Us and Kmart in 10 cities around the country. Researchers evaluated not only the lead and cadmium content of the PVC products but also how likely it was that those substances could be released into a child's body as a result of sucking, chewing or handling.

The study, which Greenpeace said was conducted by independent laboratories and reviewed by independent medical experts, found that nearly one-fifth of the 131 products contain lead levels higher than the health standard of 200 parts per million, which CPSC staff recommended as a maximum for the vinyl miniblinds.

The CPSC tested 11 of the products in which Greenpeace found high levels of lead and cadmium and found opposite results, said Ron Medford, assistant executive director for hazard identification and reduction at the CPSC. In seven of the products, the CPSC found no lead or only trace levels; in eight of the products, it found no cadmium or only trace levels.

Greenpeace said the CPSC did not replicate the group's scientific methods when testing the products.

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A Bulletin from Greenpeace

GREENPEACE

Toxic Toy Story

Children's Toys Made of Vinyl Contain Extremely Dangerous Additives Such As Lead and Cadmium

A Greenpeace investigation has revealed that toys made of PVC plastic (better known as vinyl) contain toxic additives that can leak out and be ingested by children. These chemicals may cause permanent damage to their brains, livers, and reproductive systems. These hazardous substances, which are added to PVC plastic to stabilize it or make it soft and resilient, are found in toys being sold at the nation's largest toy retailers.

All Photos © Dwayne Fremin/Greenpeace 1997

What is PVC?

PVC plastic, or vinyl, is the only common plastic to be made from chlorine. The production and accidental or intentional burning (as in incineration) of this plastic produces the deadly chemical dioxin, which has been linked to cancer as well as developmental and reproductive damage.

But PVC is also unique among plastics in another way. Because PVC by itself is hard, brittle, and unusable, a variety of chemicals are added to make finished vinyl products. Because these additives are generally not bound strongly into the plastic, the chemicals can be released when the product is used. When children suck, chew or handle PVC toys, they can end up swallowing these toxic chemicals.

Two Types of Hazardous Additives

■ **Stabilizers** are added to all PVC products to keep them from degrading. Two of these stabilizers are among the most alarming additives to PVC: lead and cadmium. Lead poisoning is widely recognized to be one of the most serious preventable public health hazards. Even extremely low doses cause permanent damage to the human brain, leading to decreased intelligence. It is even possible to predict how much a child's I.Q. will drop for every increase of lead in the blood. Cadmium is even more toxic than lead—it causes kidney damage and is linked to cancer.

■ **Plasticizers** are used to make PVC soft or flexible. These chemicals are used in such large quantities that they can account for nearly half the weight of vinyl products like children's raincoats and some baby toys, including teethers. European studies conducted by government scientists show that when children put soft vinyl toys in their mouths, they can swallow dangerous levels of plasticizing chemicals called phthalates (pronounced thay-lates). Phthalates have been linked to damage to the kidneys, liver and sex organs.

Why is Lead Still Being Used?

The PVC industry has claimed for a number of years that lead can be easily replaced by other, less toxic, substances. Yet lead continues to be widely used in PVC products. Either the industry claim is not true, or producers do not regard lead poisoning as an urgent concern. In June 1996, U.S. government officials, media and the American public were shocked when it was discovered that vinyl mini-blinds contained high levels of lead which children could ingest as a surface dust. More than a year later, Greenpeace has found almost identical results for a wide range of PVC children's products. Children are likely suffering as a result.

The Safe Solution: Eliminate PVC

Exposing children to PVC's toxic additives is a health risk that is avoidable. Many kinds of plastics are soft and flexible without adding plasticizers. And PVC only needs lead and cadmium

CONTINUED

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stabilizers because it is made from chlorine—unlike all other common plastics. The vinyl industry may promise to replace the toxic additives by "safer" ones—but in the past this has meant replacing a well-studied toxic chemical by a less well-studied toxic chemical. **The safest solution is for toy manufacturers and consumers to avoid vinyl altogether.**

What You Can Do:

1 Don't buy vinyl or PVC products. PVC or vinyl children's products that you've already purchased should be returned to the manufacturer or retailer.

2 Contact your state health authority and urge them to investigate toxic additives to vinyl products.

3 Call the following trade associations, retailers, distributors, and manufacturers and demand that they discontinue vinyl children's products.

Hasbro 1-800-242-7276
Mattel 1-800-524-8697
Playschool 1-800-752-9755
FisherPrice 1-800-432-5437
Gerber 1-800-443-7237
Safety First 1-800-723-3065
Toys R Us 1-201-368-5532
KMart 1-810-643-1000
Walmart 1-501-237-4000
Warner Brothers 1-800-843-2341
Disney 1-800-328-0612
Toy Manufacturers of America 212-675-1141

4 Check out Greenpeace's Web site (address below) for the latest information on our PVC campaign. Also available online are the complete test results and comprehensive lists of the products tested, contained in the Greenpeace report *Lead & Cadmium in Vinyl Children's Products: A Greenpeace Exposé.*

Play Safe
BUY PVC FREE

GREENPEACE

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The Product Test Results

Lead and Cadmium

Greenpeace tested more than 100 randomly selected consumer products made of PVC plastic (also known as vinyl), including many designed for children. The following products, listed with their retail outlets, were near to or exceeded lead and cadmium levels determined to be hazardous by the U.S. Government.

101 Dalmations Backpack
Kmart

Barbie Backpack
Kmart

2-lb. Vinyl-Covered Barbell
Target

Breast Milk Cooler
Medela

Sega Controller Cable
Toys R Us

Gemini 3' Video Coaxial Cable
Kmart

Gemini Phone Cord
Kmart

Philco In-Ear Headphone Cable
Kmart

Philco Headphone Cable
Kmart

AT&T 25' Phone Line Cord
Kmart

Gemini Computer Printer Cable
Kmart

Disney Minnie Totes Key Ring
Target

Fun d Mentals Pencil Case
Kmart

Warner Brothers Space Jam Placemat
Kmart

Barth & Dreyfuss Placemat
Kmart

Gloria Vanderbilt Placemat
Wal-Mart

Pacific Kids Purse
Wal-Mart

Tweety Rainhat
Warner Bros

Columbia Youth Parka Raincoat
Uncle Dan's

Springs Bath Shower Curtain
Wal-Mart

Barbie Slumber Tent Pole
Toys R Us

Tweety Totebag
Wal-Mart

Looney Tunes Hackey Sack Toy
Toys R Us

Kentucky Fried Chicken Toy
Toys R Us

Toteables Cosmetics Pouch
Target

Dimples Doll Stroller
Toys R Us

Looney Tunes Umbrella
Toys R Us

Phthalates/Softeners

Greenpeace tested vinyl toys designed for very young children, including teethers, for the presence of hazardous additives known by the scientific term phthalates, used to soften plastic.

All soft PVC products contain these hazardous chemicals. Below is a partial list of products tested, listed with their manufacturer or distributor.

Soft'n Munch Dessert Teether
Safety 1st Inc.

Barnie Fun TIme Baby Bop Doll
Child Dimensions/Hasbro

Sof'Sport Teether
Safety 1st Inc.

Hard'n Soft Fruits Teether
The First Years/Kiddies Products

SofKey Teething Ring
Australia

Silbiditos Tiger ("Tigger")
Disney/Arco Toys/Mattel

Pig and Cow Weebles
Hasbro

Teether Album, Disney Babies,
Playskool Baby Inc./ Hasbro

Soft Teether Keys
Nursery Needs/Sanitoy

Alternatives to PVC Products

Safer alternative materials to vinyl or PVC plastic are widely available. But because most children's products are not labeled, it's difficult for consumers to avoid vinyl. If you have questions about a specific product, call the manufacturer or retailer (some are listed at left). Also ask these companies to stop selling vinyl products.

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BACKGROUND INFORMATION ON SOFT PVC TOYS

In 1996, Greenpeace began an investigation into soft PVC toys. What we uncovered was startling. We found that soft PVC toys can contain hazardous chemicals, sometimes in substantial quantities and that these chemicals can leach out of the toys. Other studies have shown that some of these chemicals, called phthalates, have not been thoroughly studied to assess hazard.

Next, we contacted and met with the International Council of Toy Manufacturers, only to discover that toy manufacturers do not believe that a safety concern exists. European governments and toy retailers, however, are taking the issue seriously and have begun to take action.

This briefing paper focuses on one PVC product group - toys. The paper provides information about the potential hazards of PVC toys during use and about alternative materials for specific applications.

PVC - AN ENVIRONMENTAL POISON

Given current scientific knowledge, coupled with the precautionary principle, Greenpeace believes that the manufacture of PVC products should be phased out. Polyvinyl chloride plastic poses unacceptable hazards to humans and the environment throughout its lifecycle (manufacture, use, and disposal). Furthermore, alternative materials are readily available to replace PVC in most applications.

The lifecycle hazards of PVC include:

(1) environmental releases of byproducts of ethylene dichloride (EDC) and vinyl chloride monomer (VCM) production;

(2) the creation of extremely toxic dioxins in the EDC and VCM production process and in the incineration of PVC products and production wastes.

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(3) the release of acutely toxicand corrosive hydrogen chloride gas and creation of dioxins in PVC fires. Dr. Yves Alaire at the University of Pittsburgh has estimated that a 20 inch piece of PVC conduit can produce enough hydrogen chloride gas to kill a human in an average-sized room; and

(4) the toxicity and potential for leaching, volatilization, or migration of PVC additives, including stabilizers, plasticizers, biocides, colorants, and flame retardants. Recent evidence regarding the hazards to children posed by lead leaching from vinyl miniblinds is one such example of the dangers of PVC additives. Leaching of phthalates from PVC toys has also been identified as a potential hazard to children.

LEACHING AND TOXICITY OF PVC PLASTICIZERS

The emerging science on the hazards of plasticizers used in soft PVC products provides substantive evidence which indicates that soft PVC presents unacceptable risks during use. Additives, such as plasticizers and stabilizers, are a necessary component of all PVC formulations. Without these additives, PVC is brittle, degrades easily, and is unversatile. Softeners are not chemically bound to the PVC polymer, but rather float around the polymer, like water in a sponge, giving the plastic the flexibility required.

As a result, it is evident that plasticizers used in PVC will leach,volatilize, or migrate from a product over time. This has long been recognized by the PVC industry itself. Pressure on a PVC product will increase leaching substantially. Of most concern is the leaching of plasticizers resulting from sucking or chewing on soft PVC toys, representing a direct bodily dose of these chemicals to the infant or child.

The main group of plasticizers used in PVC, the phthalate esters or phthalates, are the most abundant human-made class of chemicals found in the environment. More than 90% of phthalates are used in PVC production. As a class, the phthalates are moderately persistent and can bioaccumulate in fat tissue. Some may be broken down in the body, although degradation and excretion rates may differ between adults and children. In addition, phthalates absorb strongly to soil, and biodegrade slowly, creating the potential for constant human exposure.

Phthalates can exert additive effects when present as mixtures or in combination with other common environmental contaminants. Many of the phthalates are actually isomers of compounds of a similar carbon chain length. As a result, a single phthalate formulation may be contaminated with several different types of phthalates. Also, a single phthalate may differ in qualities from producer to producer or even batch to batch.

Laboratory research on the health effects of the phthalates has identified wide-ranging chronic effects.

These include: (1) liver and kidney lesions: (2) reproductive abnormalities, including testicular atrophy, altered development of reproductive tissues and subtle effects on sperm production, (3) cell line transformations and (4) cancers, including those of the liver, kidney, and mononuclear cell leukemia.

Clearly, exposure of children to such chemicals presents unacceptable and avoidable hazards. Compared to adults, children may be at risk of suffering greater effects from exposure to chemicals due to their increased intestinal absorbability, increased skin absorption, increased cell turnover in the liver, and less developed protection and communication mechanisms between the brain, the gonads and other parts of the body.

Although historically the most commonly used plasticizer in toys, di (ethylhexyl) phthalate, DEHP, was voluntarily withdrawn by many toy manufacturers selling products in the US, when the International Agency for Research on Cancer declared DEHP a probable human carcinogen in the 1982. This action was taken in response to the US Consumer Product Safety Commission's (CPSC) investigation into the hazard to children of DEHP in toys. Market reports have shown that uses of DEHP have been replaced predominantly by diisononyl phthalate (DINP), which has been shown to produce tumors and other chronic effects in laboratory animals.

Studies conducted by CP Hall, a manufacturer of phthalates, showed that the most common phthalates do leach from PVC. A study by the CPSC has shown specificially that DEHP can leach from toys. Furthermore, a Health Canada study concluded that exposure to such toys could add substantially to the daily intake of phthalates by children.

PVC PLASTICIZERS AND ENDOCRINE DISRUPTION

An emerging concern about the phthalate esters is their ability to disrupt the endocrine, or hormone, system. Several scientific studies have demonstrated that some phthalates, including butylbenzyl phthalate (BBP), dibutyl phthalate (DBP) and diisononyl phthalate (DINP), are capable of binding to the estrogen receptor in human cell lines and of weakly mimicking the action of estrogen.

The Association of European Toy Manufacturing Industries have stated:

"In vitro tests in laboratory test tubes as well as the more relevant in vivo studies have yielded no evidence that the most common, commercially significant phthalates produce any endocrine modulating effects or display estrogenic activity."

Recent research has show this to be demonstrably untrue. A paper published in August 1997 has demonstrated that DINP, perhaps the most commonly used phthalate in soft PVC toys, does show weak estrogenic activity in in vitro tests with human cell cultures.

The endocrine system is an extremely sensitive chemical messenger system (sensitive in the range of parts per trillion), which regulates important bodily functions such as: development of the embryo, cell programming, organ development, brain function and behavior, growth, metabolism, stress response, and immune system functions. Concerns over the ability of chemicals to interfere with hormones stems from observations in animals or in cloned cells. Nevertheless, the close similarities between the hormone system in humans and animals suggest that effects in animals may give important indications of potential impacts in humans.

The effects of endocrine disruption are often subtle and may not be observed until the next generation. Known or suspected effects of endocrine disruption include: damage or abnormalities to the reproductive tract or organs, reduced and damaged sperm, infertility, immune suppression and reduction in cognitive abilities.

ALTERNATIVE MATERIALS FOR PVC IN TOYS

A variety of plastic and non-plastic alternative materials exist for PVC toys. However, no one can guarantee that any plastic is safe in a child's mouth. We know that some plastics do not need phthalate additives and do not have the same tendency to leach as soft PVC. We also know that additives for soft PVC toys present a potential hazard.

The following survey of alternatives is by no means exhaustive and does not include a thorough analysis of product safety issues associated with alternative polymers. However, it is important to note that there are readily available, cost-competitive alternatives to PVC in toy production. In some cases, these alternatives are already replacing PVC in toys applications.

Uses of PVC in toys can also be replaced with traditional materials such as wood, cloth and natural rubber. These alternative materials were often used for toys before the rapid increase in plastics use and should be considered among the best alternatives.

This analysis has focused primarily on uses of PVC in "soft" toys, such as inflatable toys, teethers and squeeze toys, dolls, etc. Hard PVC applications, such as block letters, can be directly and immediately substituted with numerous alternatives (e.g., polyethylene and polypropylene).

The alternatives to PVC can be divided into thermoplastic and elastomeric alternatives. Many of the alternatives are co-polymers (two different polymers linked together) or alloys/blends (polymer mixtures). Alternatives can be further divided by the type of application sought and the processing method. In general, design requirements and characteristics for the product (e.g., colorfastness, stability), as well as ease of processing and cost will drive the choice of material.

Greenpeace is not endorsing any of these materials.

Thermoplastics

Polyethylene: Polyethylene (PE) is the most widely used plastic in the world today. The polyethylenes are extremely versatile and can be made from hard to soft as soap by modifying hydrocarbon chain length or cross-linking. No additives are needed to soften polyethylene.

Polypropylene: Polypropylene (PP) is easily processed by all methods and offers good material properties, such as low density, good mechanical, temperature, flexing/fatigue, and stress-crack resistance, and rigidity. Many of the properties of polypropylene are similar to those of polyethylene. For example, PP characteristics can be varied from hard to soft and flexible. As with polyethylene, polypropylene requires no plasticizers for flexibility.

Thermoplastic Elastomers (TME)

An elastomer is a material which exhibits rubber-like properties of high extensibility and flexibility, is available in a wide range of hardness, and has the ability to snap back quickly after being extended to at least twice its length. The thermoplastic elastomers in general have very good flexibility, high tensile strength, are compatible with a wide range of colors, are relatively easy to process, and do not require plasticizers. Traditional thermoplastics can be added to elastomers to increase impact resistance or tear strength.

Styrene-Ethylene-Butylene-Styrene (SEBS):

SEBS is a thermoplastic elastomer . The advantages of SEBS are: Possible injection and rotational molding of hollow bodies (e.g., dolls heads); surface quality as desired; permanent colors after painting; durability; lack of breakage (crumbling); no plasticizers are needed. SEBS is already used in both the production of sports equipment and toys.

Ethylene Vinyl Acetate (EVA): EVA is a copolymer of polyethylene and vinyl acetate. It is flexible, resilient, and resistant to cracking and contains no plasticizers or other additives. EVA is used where flexibility, resilience, dielectric sealability, toughness, and compatibility are required.

Polyethylene Ethyl Acrylate Copolymer (PEEA): PEEA is a copolymer of polyethylene and ethyl acrylate. PEEA is tough and rubbery and at room temperature has about the same flexibility as plasticized PVC and about four times the flexibility of low density polyethylene (LDPE).

Styrene-Butadience Block Copolymers (SBS). SBS were the first of the thermoplastic elastomers and have a wide range of hardness, good low-temperature performance, rubbery feel, resistance to cutting and cracking, and good abrasion and environmental resistance.

The majority of the alternatives mentioned above are of high strength and durability. As product safety is a critical concern for toy manufacturers, alternative materials must be thoroughly investigated in terms of cracking and breakage; toxicity and leachability of additives (if necessary for the material); and lifecycle hazards (production, use, and final disposal).

SUMMARY

Given scientific evidence regarding the chronic effects of PVC plasticizers in laboratory studies, the potential high exposure and the increased vulnerability of children to the effects of chemicals, and the emerging science of endocrine disruption, the weight of evidence indicates that the use of PVC in children's toys presents unacceptable and avoidable hazards.

Furthermore, the well known chronic effects of dioxin, inherent in PVC production and in the disposal of PVC products via incineration in the municipal solid waste stream, also present an unacceptable environmental and public health risk associated with PVC production.

Action to eliminate PVC use in toys is now warranted to prevent children's direct and indirect exposure to these hazards.